DACCF Utilities Installation Guide and User Manual

Part Number 771953-D02

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About this Manual

This manual covers the steps involved to install and use the Mylex Disk Array Controller Configuration Utilities (DACCF) software.

This manual is divided into a number of sections, presented in the order in which they are needed over the life of your disk array:

- **Introduction to DACCF** provides a brief introduction to the Disk Array Controller Configuration Utilities. Here you'll find a description of the software, the functions it provides, when it can (and should) be used, and the environment needed for using the utilities.
- **Configuration Strategies** presents some scenarios and suggestions for configuring your array for optimal performance. Look here for information on how the DAC960 implements RAID technology and for tips on making your array perform well in your specific application.
- **Preparing the Array** covers array hardware preparation, configuration, and initialization. After completing the steps in this section, you can install the operating system for your specific environment.
- **Administering the Array** describes the tasks that can be done to the array after it has been placed in service. This includes array tuning, recovery after a power failure, management of the array after a hardware malfunction, tools, and diagnostics.

For information on setting the controller's SCSI termination jumpers and connecting the disk drives, consult the appropriate DAC960 Series Disk Array Controller Installation Guide.

Conventions

Throughout the manual, the following conventions are used to describe user interaction with the product:

`bold`	the user must enter the bold text exactly as shown
↵	press the Enter key
Enter	press the key labeled “Enter” (or “Delete”, etc.)
File, Run	select the Run option from the pull-down menu activated when the File menu pad is selected

Note	Supplementary information that can have an effect on system performance
Caution	Notification that a proscribed action has the *potential* to adversely affect equipment operation, system performance, or data integrity
WARNING	Notification that a proscribed action will *definitely* result in equipment damage, data loss, or personal injury

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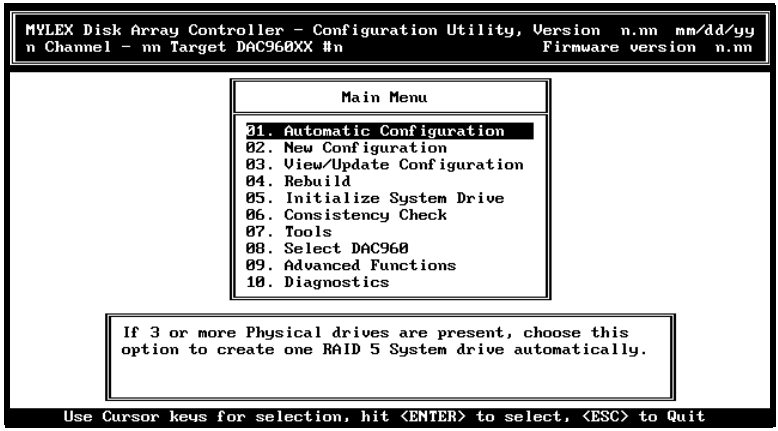
Chapter 1
Introduction to DACCF


MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
If 3 or more Physical drives are present, choose this option to create one RAID 5 System drive automatically.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Overview

The DACCF software tools are located on the DAC960 Configuration & Utilities diskette that is supplied with all Mylex DAC960 Series Disk Array Controllers.

What is DACCF?

DACCF is an acronym for the **D**isk **A**rray **C**ontroller **C**on**F**iguration utilities. It is a set of MS-DOS compatible programs used to configure, initialize, and manage RAID (Redundant Array of Independent Disks) subsytems connected to a Mylex DAC960 Series controller.

DACCF utilities provide the necessary software tools needed to get the disk array up and running, as well as advanced functions for monitoring, controlling, and managing DAC960 Series controllers and their connected disk array subsystems.

When to Use DACCF

You should use DACCF utilities:

- To configure and initialize an array during initial system setup, before loading the operating system
- To save the array configuration information to a disk file
- To periodically monitor the state of various devices within an array
- To verify disk integrity after a power failure to an array by running a consistency check
- To take drives on-line or off-line during a drive replacement operation
- To perform diagnostics on an array controller
- To obtain specific information about a device in an array
- To reconfigure and otherwise "tune" an array for optimal performance and availability

WARNING

Reconfiguring logical drives on an existing array will result in data loss. Make sure that all data is backed up on different media before performing this task.

How to Use DACCF

Describing how to use DACCF is similar to answering the question, "How do you awaken an 800-pound gorilla?"

That is, "Very carefully."

While DACCF provides many safety prompts that alert you when you are about to take an action that can affect data or drive status, you should be aware from the outset that DACCF is meant to be used only by persons with Manager or Supervisor rights. These are powerful utilities that must be used properly, or data loss can result. You should not have a problem, however, if you follow the instructions in this manual, observing any Notes, Cautions, and Warnings, before performing an operation.

In addition, it is a good idea to have a written plan that identifies the system resources (e.g., devices, capacities, locations by SCSI channel, target ID, etc.) and the desired logical drive configurations (LUN sizes, RAID types, etc.) before you begin setting up or changing an array configuration.

Functions Provided by DACCF

Configuration

One of the primary functions of DACCF is to create logical storage units (also known as logical disk drives) from an array of physical disk drives. A defined size (or capacity) and a particular RAID level is associated with each logical drive. Once defined and initialized, these logical drives are presented by the DAC960 Series controller to the operating system.

> **Note:** Run DACCF to configure and initialize the array *before* installing the operating system, programs, or data onto the disk array.

While DACCF allows for unlimited customization in the configuration of logical drive sizes and RAID levels associated with these drives, an automatic configuration option is available as well. When invoked, this option will optimize the amount of available capacity, performance, and fault-tolerance for a given number of physical disks. If you're new to the concept of RAID, we recommend that you select automatic configuration for a first-time installation.

Initialization

After an array has been configured, it must be initialized. The initialization process is similar to, but not the same as, formatting of a disk. Array initialization is performed from within DACCF.

Managing the Array

After the array has been configured, initialized, and loaded with information, DACCF is used to manage the array, particularly when an environmental, system, or hardware malfunction occurs that could put data stored in the array at risk. DACCF provides the tools to selectively take drives on-line or off-line, and to rebuild (or reconstruct) data on a failed drive's replacement. In the case of a power loss, potential data corruption can occur. DACCF can be used after power restoration to perform a consistency check to locate (and correct, if necessary) any data errors on the drives.

Diagnostic and Configuration Utilities

DACCF can run diagnostic routines against the DAC960 controller and to back up, restore, and print controller configuration data to a disk file.

DACCF Requirements

DACCF has the following requirements for successful execution:

Hardware

- Either a stand-alone or host-based Mylex DAC960 Series controller
- If the DAC960 Series controller is connected to the computer via a SCSI cable, an approved SCSI Host Bus Adapter is necessary.
- An 80386-class (or newer) CPU
- A video adapter (any type)
- A floppy disk drive

Software

- MS-DOS 5.0 or later
- ASPI drivers for the host adapter (if the DAC960 Series controller is connected to the computer via a SCSI HBA)
- SLPCF drivers for the terminal emulation program (if the DAC960 Series controller is connected to the computer via a serial communications port)

Installing DACCF

Procedure

DACCF should be run from a floppy diskette. We recommend you make a backup copy of the DACCF Configuration & Utilities diskette on a bootable diskette, and run the program from this diskette:

1. Create a bootable floppy disk using the MS-DOS *Format* utility with the */S* parameter. For example, if your floppy disk drive is designated as A:, enter the following command at a DOS command prompt:

   ```
   FORMAT A: /S
   ```

2. Copy the programs DACCF.EXE and DACD.EXE from the DAC960 Configuration & Utilities diskette to the bootable floppy disk. The programs are located in the DACCF directory of the utility disk.

   Alternatively, MS-DOS *Diskcopy* can be used to create a backup copy of the utility disk. For more information on using this utility, consult the MS-DOS reference materials that accompanied your system.

Adding SCSI-to-SCSI Drivers

When the system uses a DAC960 Series SCSI-to-SCSI controller, additional files are needed on the bootable floppy.

For controllers that are connected to the host system through a SCSI host bus adapter (HBA), you should also copy the HBA's ASPI*xxxx*.SYS device driver onto the bootable floppy (where *xxxx* represents the manufacturer's specific device driver name).

For systems that are communicating with a DAC960S Series SCSI-to-SCSI controller through a serial port (a null modem cable connected between COM1 on the host and the serial port on the controller), you should copy either the SLP1TK.EXE or TERM7.EXE utility onto the bootable floppy, depending on the requirements for your terminal or terminal emulation software.

Make sure that the appropriate driver will load from the bootable floppy; for example, update the CONFIG.SYS file to include the line:

```
device=a:\aspixxxx.sys
```

where xxxx identifies the particular ASPI device driver you have.

Chapter 2
Configuration Strategies

Overview

The information in this chapter is designed to help you choose the right configuration for your disk array. It introduces the following:

- Some disk array applications
- The essential RAID terms and techniques you will need to know
- The CAP strategy for selecting the best possible configuration
- Tables to help you match RAID levels to available drives

Understanding the CAP strategy will help you to achieve your storage goals – to maximize storage **C**apacity, to assure data **A**vailability, to provide the best possible I/O **P**erformance, or to utilize combinations of the three.

What's the Purpose of Your Array?

That's the first question you'll need to ask yourself before you start preparing to configure your array. Will you be using the array to increase the capacity of your general purpose file and print server? Will you be using it to support a database application that has to keep running 24 hours a day? Is the array going to contain large files of audio or video clips that can be played back on demand? Is the array going to be used as a repository for imaging systems?

What is the Data Access Profile?

Each of the above applications has a different access profile – that means the type and frequency of read and write activity that is performed against the array over the course of time. Identifying the data access profile will help you determine a strategy favoring capacity, availability, or performance.

For example, so-called “video” servers typically write data (i.e., the video clip) infrequently, but play back the data very often. The ratio of reading to writing in this type of an array is far different from a general-purpose file server that’s doing small read and write operations all day long. In addition, the characteristics of the files themselves are very different – video and image files are typically very large when compared to letters, memos, and spreadsheet files. Video server applications (or, in general, all imaging applications) need to read very large segments of data, compared to the relatively small data segments found with spreadsheet or text documents.

RAID Essentials for DAC960 Series Controllers

You’ll get a better idea of how to configure your disk array if you understand how DAC960 Series controllers implement RAID technology and organize the disk drives. Correct installation of the disk array and the controller requires a proper understanding of RAID technology and the concepts described in this chapter.

RAID is an acronym for Redundant Array of Independent Disks. DAC960 Series controllers implement several different versions of the Berkeley RAID technology, and some other special versions that are specific only to the DAC960 product family. Each RAID version (referred to as a RAID level) supported by the DAC960 is shown in the table on the next page.

An appropriate RAID level must be selected when system drives are defined or created. This decision is based on the following priorities:

- Disk capacity utilization (number of drives)
- Data redundancy (fault tolerance)
- Disk performance

DAC960 Series controllers make the RAID implementation and the disks’ physical configuration transparent to the host operating system. This means that the host operating system drivers and software utilities are unchanged, regardless of the RAID level selected.

Selecting the Right RAID Level

Selecting the proper RAID level for a specific data storage application requires that consideration be given to the benefits of each technique.

RAID 0 – Striping

The controller stripes data across multiple drives.

Benefits: Very high data throughput, especially for large files.

Drawbacks: Does not deliver any fault tolerance. All data is lost if any drive in the array fails.

Uses: Intended for non-critical data requiring high performance.

Drives: Minimum, 2. Maximum, 8.

Table 2-1. DAC 960 Supported RAID Levels

RAID Level	Description	Fault Toler.?
0	Block striping is provided, which yields higher performance than is possible with individual drives. No redundancy is provided.	No
1	Drives are paired and mirrored. All data is 100% duplicated on an equivalent drive.	Yes
5	Data is striped across several physical drives. Parity protection is used for data redundancy.	Yes
0+1	Combination of RAID levels 0 and 1. Data is striped across several physical drives. This level provides redundancy through mirroring. (Mylex RAID 6)	Yes
JBOD	"Just a Bunch of Drives." Each drive is operated independently like a normal disk controller; or multiple drives may be spanned and seen as a single large drive. This level does not provide data redundancy. (Mylex RAID 7)	No
Striped 0+1 Striped 5	Also known as 0+1+0 and 5+0; these two variants combine striping either with RAID level 0+1 or with RAID level 5.	Yes

RAID 1 – Mirroring

The controller duplicates data from one drive to another.

Benefits: Provides 100% data redundancy. Should one drive fail, the controller simply switches reads and writes to the other drive.

Drawbacks: Requires two drives for the storage space of one drive. While a controller is rebuilding a drive, users will experience reduced performance if they try to read or write data.

Uses: When array availability is most important.

Drives: Minimum, 2. Maximum, 2.

RAID 5 – Striping with Parity

The controller stripes blocks of data and parity information across all drives.

Benefits: Uses a fraction of the disk space required by RAID 1 to achieve data redundancy. Provides good performance for transaction processing applications because each drive can read and write independently. Should a drive fail, the controller continues to allow reads and writes by calculating the missing information using the parity data. The controller can recreate lost data on a replacement drive without interrupting access by users. It can perform the rebuild automatically if a hot spare is available, or the system administrator can manually initiate a rebuild.

Drawbacks: Cannot match RAID 0 in write performance because of the processing required to compute and write error-correction data. While a controller is rebuilding a drive, users will experience reduced performance if they try to read or write data to the array.

Drives: Minimum, 3. Maximum, 8.

RAID 0+1 – Mirroring and Striping

The controller combines the functions of both data striping (RAID 0) and disk mirroring (RAID 1). (Sometimes referred to as Mylex RAID 6.)

Benefits: Optimizes for both fault tolerance and performance. Provides excellent performance for all data needs.

Drawbacks: Requires half the available disk space for data redundancy, the same as RAID level 1.

Drives: Minimum, 3. Maximum, 8.

JBOD – Single Drive Control

Just a Bunch of Drives – the controller treats each drive as a stand-alone disk and provides a high-performance cache. (Sometimes referred to as Mylex RAID 7.)

Benefits: Cache reduces the amount of time the computer has to wait for a disk to get to the right place to read or write data.

Drawbacks: Does not provide data redundancy and does not use striping for performance enhancements.

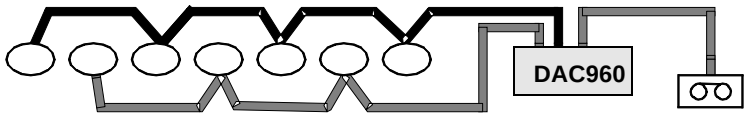
Drives: Minimum, 1. Maximum, 1.

Managing Physical Drives and SCSI Devices

You must organize physical disks into drive groups and logical drives that can support the various RAID levels.

Physical disk drives are connected to one (or several) of the DAC960 SCSI channels, as shown below. When using a DAC960 Series controller with two or more channels, it is recommended that disk drives be evenly distributed among the available SCSI channels for optimal performance. This will minimize the effect of any overhead relative to the SCSI bus arbitration scheme.

DAC960 Series controllers can also be used to control non-disk SCSI devices. To maximize disk drive performance however, tape, CD-ROM and other non-disk SCSI devices should be connected together on a separate channel. The example below shows a three-channel DAC960.

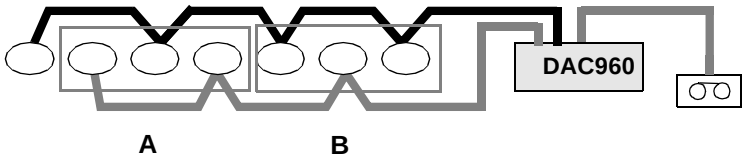


Drive Groups

Organize the disk drives into drive groups, or “packs,” after they are connected to the controller, formatted, and initialized (these procedures are described in “Chapter 3: Preparing the Array.”

Up to eight drive groups are supported per controller. Drive groups are identified alphabetically (A through H) by the DACCF utilities. From one to eight drives can be included in an individual drive group. The number of drives in a drive group determines the possible RAID level.

The following illustration shows a single drive, not included in any drive group, and two drive groups (A and B), each with three drives.



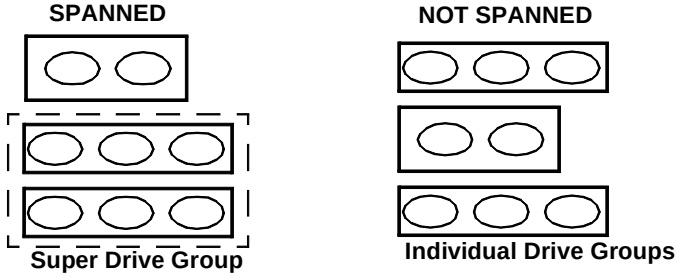
Arranging Drive Groups

After drive groups have been created, they need to be arranged. Arranging drive groups provides a means to further organize the array. For example, Drive Group B in the previous illustration can be arranged to be the first drive group on the controller. This would permit the creation of a primary system drive on Drive Group B that could function as a boot drive.

By sequentially arranging two drive groups with an identical number of disk drives, each drive group's capacity is combined, or *spanned*, creating a *Super Drive Group*. Such arrangement is done automatically by the DAC960 controller when two drive groups with an identical number of disks are arranged, one after another. Data is striped across the drive groups of the Super Drive Group, irrespective of how data is distributed across the individual drive group. A system drive can span across up to four (4) drive groups.

Arranging drive groups so that a pack with a different number of drives is in between two groups of equal number drives will prevent this spanning feature from being enabled. Another simple way to prevent automatic spanning is to completely finish arranging a drive group, defining its RAID level and system drives, and initializing the array before continuing on with creating another drive group that contains the same number of drives.

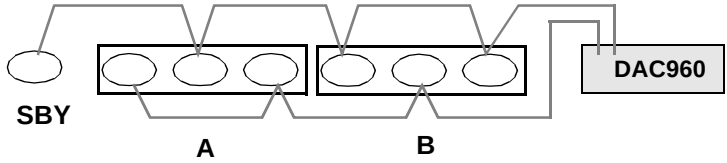
In the following illustration, a Super Drive Group, on the left, has been created with the effective capacity of six disk drives because the drive groups, with three drives each, are arranged sequentially. In the example on the right, three unspanned drive groups have been created: two groups of three drives, and one group of two drives.



Standby/Hot Spare Drives

Drives that are not included in any drive group at the time of configuration with DACCF are automatically used by the DAC960 controller as standby, or hot spare drives. DACCF denotes standby drives as SBY. There is no limit on the number of available drives that can be configured as standby drives.

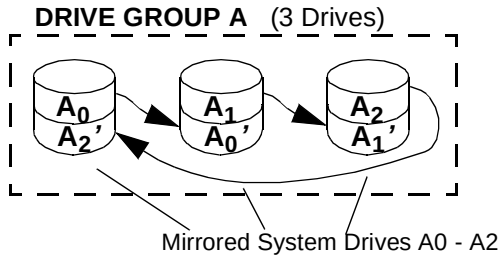
Two arranged packs and a standby drive are shown in the following illustration. Notice that what is being illustrated is how the controller is organizing the drives; since the cabling scheme depicted in this configuration is the same as the one shown in the first illustration. The physical capacity of the drive group is six drives, but the effective capacity will be less, after normal RAID capacity utilization is taken into account.



System (Logical) Drives

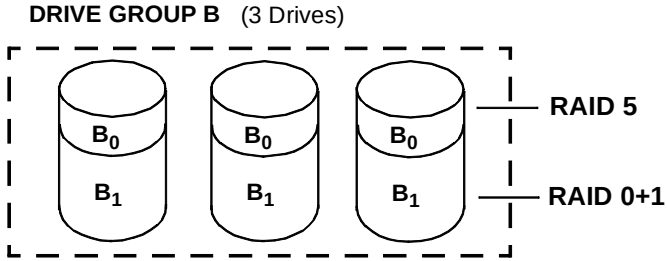
After all the physical drive groups are defined and arranged, one or more system drives must be created. System drives are the *logical drives* that are presented to the operating system.

A system drive's capacity can encompass any portion of a drive group (up to the total capacity of that drive group), or the capacity of more than one drive group (up to four drive groups). Up to eight system drives can be created with DAC960 firmware versions below 2.6. With firmware versions at or above 2.6, up to 32 system drives can be created per controller. The following illustration shows a RAID 0+1 configuration with three mirrored system drives created in a drive group containing three disk drives.



Assigning RAID Levels to System Drives

Each system drive has a defined RAID level (0, 1, 5, 0+1, JBOD) based on the number of drives in the drive group upon which it is created. If a drive group has enough drives to support several different RAID levels, the system drive can be assigned any of the *available* levels. However, a system drive may have only *one* RAID level.



In the illustration above, the smaller system drive (B_0)can be assigned a RAID 5 level of operation, while the larger system drive (B_1)might be assigned a RAID 0+1 level of operation.

Remember that different RAID levels exhibit different performance characteristics for a particular application or environment. DAC960 Series controllers allow for complete versatility in this regard, by allowing multiple, different RAID levels to be assigned to a drive group.

Matching RAID Levels to Available Drives

You may be asking, “How many drives do I need for a certain RAID level?”

The table below provides this information.

DACCF looks at the number of drives in a drive group and presents you with only those RAID levels that have enough drives to support the choices.

Table 2-2. RAID Levels vs. Number of Drives

RAID Level	Number of Drives	
	Minimum	Maximum
0	2	8
1	2	2
0+1	3	8
5	3	8
JBOD	1	1
Striped 0+1 Striped 5	4*	32*

* The striped 0+1 and striped 5 RAID levels can only be implemented on Super Drive Groups (i.e., spanned drive groups with the same number of drives that have been arranged adjacent to each other). Since they are striped, these RAID levels can be thought of as RAID level 0+1+0 and level 5+0, respectively.

Applying the CAP Strategies

Capacity, Availability, and Performance: these are the three benefits that all DAC960 RAID solutions have in common. The terms, collectively known as "CAP" should characterize your expectations of the disk array subsystem.

What is your best strategy for configuring the array? Do you want to access the maximum capacity of your disk drive investment? Or do you want to configure your array for a high degree of fault-tolerant operation? Perhaps performance is extremely important to you. Every installation has a different set of requirements, and most installations have a combination of these.

Unfortunately, it isn't possible to configure an array with all of these characteristics optimized; that's a limitation of the technology (as they're somewhat mutually exclusive). For example, you can't have maximum capacity and maximum availability in a single array. Some of the disks have to be used for redundancy, and in doing so, capacity is reduced.

Similarly, configuring a single array for both maximum availability and maximum performance is not an option.

You will need to make compromises. Luckily, your DAC960 Series controller is versatile enough to offer you any of these preferences, either singly or in the most favorable combination possible.

It comes down to this: you will need to decide which capability is most important for your operational environment, and which is next most important. Once you've prioritized your expectations, it should be relatively easy to configure the array to meet your expectations.

Configuring for Maximum Capacity

You may want to optimize your array for the greatest possible capacity. To see the relationship between the different RAID levels and effective capacities offered for the quantity *X* drives of *N* capacity, refer to Table 2-3. As an example, computed capacities for five drives of size 2GB each are provided.

Table 2-3. RAID Levels and Effective Capacity

RAID Level	Effective Capacity	Example: (Capacity in GB)
0	X*N	5*2 = 10
1	(X*N)/2	5*2/2 = 5
5	(X-1)*N	(5-1)*2 = 8
0+1	(X*N)/2	(5*2)/2 = 5
JBOD	X*N	5*2 = 10

As you can see, the greatest capacities are provided by RAID 0 and JBOD (Mylex RAID 7), with the entire capacity of all disks being used. Unfortunately, with these two solutions, there is no fault-tolerance.

RAID 5 gives the next best capacity, followed by RAID 1 or RAID 0+1.

Configuring for Maximum Availability

When considering optimizing for availability, it's important to understand some of the terminology concerning the condition of array operation. These definitions are presented in Table 2-4.

Table 2-4. Array Operational Conditions

Array Condition	Meaning
Normal	The array is operating in a fault-tolerant mode, and can sustain a drive failure without potential data loss.
Critical	The array is functioning and all data is available, but the array cannot sustain a drive failure without potential data loss.
Degraded	The array is functioning and all data is available, but the array cannot sustain a drive failure without potential data loss. Additionally, a reconstruction or rebuild operation is taking place, reducing the performance of the array. The rebuild operation takes the array from a critical condition to a normal condition.
Not fault-tolerant	No fault-tolerant RAID levels have been configured for any of the drives in the array.

An additional measure of fault-tolerance (or improved availability) can be achieved using a hot spare, or standby, disk. This disk is powered-on but idle during normal array operation. If a failure occurs on a disk in a fault-tolerant set, the hot spare disk takes over for the failed drive, and the array continues to function in a fully fault-tolerant mode after it completes its automatic rebuild cycle. This means that the array can suffer a second drive failure and continue to function before any disks are replaced.

Impact of Controller Cache on Availability

Every DAC960 Series controller has a disk cache. This DRAM or EDRAM physical memory is used to increase the performance of data retrieval and storage operations. The amount of disk cache varies with the controller model, but is usually on the order of 4MB of cache RAM. The controller will use this memory to store disk writes.

The controller may report to the operating system that the write is complete as soon as the controller receives the data. This is referred to as Write Back (WB) cache. This will improve performance, but will expose you to data loss if a system crash or power failure occurs before the data in the cache is written to disk.

To avoid this potential loss of data, at the very least, you should outfit your controller with a battery backup module for the cache memory. The battery backup option will enable the cache to be retained until normal operation resumes, at which time the data in the cache can be written to the array. Your data is most likely as important as your server (probably much more so), and this simple and inexpensive insurance can prevent a power interruption from turning into a disaster.

If the array controller is not (and will not be) configured to use Write Back cache, then battery backup of the cache is not necessary.

If the write cache is used without the battery backup option installed on the DAC960, then an uninterruptible power supply (also known as a UPS) should be used with your disk array.

RAID Levels and Availability

To see the relation between the different RAID levels offered by the DAC960 controller and the advantages (and disadvantages) of the RAID levels as they apply to availability, refer to Table 2-5.

Table 2-5. RAID Levels and Availability

RAID Level	Availability (Fault-tolerance)
0	No fault tolerance. Data is striped across a set of multiple disks. If a disk in the set ceases to function, all data contained on the set of disks is lost. (This configuration is not recommended if fault tolerance is needed.)
1	(Disk Mirroring). Mirrored fault tolerance. Data is written to one disk, and then the same data is written to another disk. If either disks fails, the other one in the pair is automatically used to store and retrieve the data.
5	Striped fault tolerance. Data and parity are striped across a set of multiple (at least three) drives. If any of the drives fails, the data (or parity) information from the failed drive is computed from the information from the remaining drives.
0+1	(Data Mirroring). Mirrored and striped fault tolerance. Data is striped across multiple drives, and written to a mirrored set of drives. This arrangement can survive multiple drive failures and continue to operate.
JBOD	"Just a Bunch of Disks." This configuration offers no redundancy and is not recommended for applications requiring fault tolerance.

Configuring for Maximum Performance

Your array can be optimally configured for the type of application you plan to deploy, but you should be aware that an optimal setting for one type of access profile is not optimal for all applications. What's the best RAID level for a particular application or environment? The relative performance advantages of each of the RAID levels is presented in Table 2-6.

Table 2-6. RAID Levels and Performance

RAID Level	Access profile characteristics
0	Excellent for all types of I/O activity
1	Excellent for write-intensive applications
5	Excellent for sequential or random reads and sequential writes
0+1	Excellent for write-intensive applications
JBOD	Mimics normal, individual disk performance characteristics

RAID Rules

A small, but important set of guidelines should be followed when connecting devices and configuring them to work with a DAC960 controller. They are:

1. To lessen their impact on the SCSI bus, connect SCSI-based tape, CD-ROM and other non-disk devices on a single channel which preferably does not service any disk drives.
2. If you have more than two disk drives, distribute the drives equally among all the channels on the controller. This will result in better performance. DAC960 Series controllers have between one and five channels, depending upon the model.
3. A maximum of eight devices can comprise a drive group.
4. A drive group can contain devices on any channel.
5. Include all drives of the same capacity (up to eight total) in the same drive group.
6. If configuring for a standby or hot spare drive, make sure that the standby drive size is greater than or equal to the capacity of the smallest drive in ALL the redundant drive groups.
7. When replacing a failed drive, make sure that the replacement drive size is greater than or equal to the size of the smallest drive in the affected drive group.

CAP Strategy Questionnaire

You need to answer the following questions before configuring the array.

I have ____ disks to be used in the array.

Rank the following statements in order of importance: 1, 2, and 3:
I want to emphasize capacity____
I want to emphasize availability _____
I want to emphasize performance _____

I have ____ channels on the array controller (Usually 1, 2, or 3)

I plan to ___ not to ____ use a Hot Spare disk.

I do ____ do not _____ have a battery backup for the controller cache.

I do ____ do not _____ have a UPS for the array.

Using the Array Configuration Tables

With all this to keep in mind, for a given number of drives, what should you do? The tables on the following pages make some suggestions for configuring from one to eight drives. Use the tables as follows:

1. **Locate the number of drives you will use.**
   This starting point is in the first column of the table (Drives and Drive Groups). Remember to apply the RAID Rules to the configuration, particularly when connecting drives to the controller.

2. **Determine how many drive groups you want.**
   Select from the example configurations for the number of drives that you have (the DAC960 supports up to eight drive groups). In the table, each drive group is indicated by a letter – A: through H:. Use as few drive groups as possible to cover your needs. Configured drives are indicated by **o**. Drives that are not part of any drive group are indicated by ***o*** (italicized) and are available for use as standby drives.

3. **Select the RAID level.**
   Apply your CAP strategy and select a RAID level for each drive group that will best meet the capacity, availability, and performance needs for your particular application.

Key Points About the Tables

Here are some key points to consider when using the tables:

- To determine the approximate **capacity** of a particular configuration, assume that each physical disk has a unit capacity of one. The value in the *Effective Capacity* column will indicate the effective available capacity for a drive group with a given RAID level.
- A configuration is fault-tolerant, or has enhanced **availability** if there is an asterisk after the value in the *Effective Capacity* column. The number of asterisks is proportional to the level of fault-tolerance, or availability, that a configuration will exhibit. The more asterisks, the better the fault tolerance.
- To determine the **performance** of a given configuration, correlate the configuration's RAID level with the application as presented in Table 2-6 on page 2-15.
- Drives that are not affiliated with a drive group are assumed to be hot spare, or **standby** drives**,** and provide an additional measure of fault-tolerance. The use of standby drives with redundant RAID levels is indicated in the *Possible RAID Levels* column as SBY.
- In most of the configurations, **multiple RAID levels** can exist for a given drive group. These multiple RAID levels can be implemented in the same drive group on different system drives. A system drive can be any percentage of a drive group. Eight system drives are allowed per controller under firmware versions below 2.6. Under firmware versions at or above 2.6, 32 system drives are allowed per controller. If different RAID levels are configured for a single drive group, then the effective capacity will be different than the value shown in the table, due to the fact that the table does not take into consideration the mixing of RAID levels within a drive group.

Table 2-7. Array Configuration Strategies

Drives & Drive Groups	Possible RAID Levels	Effective Capacity
One Drive		
A: o	A: JBOD	A: 1
Two drives		
A: o B: o	A: JBOD B: JBOD	A: 1 B: 1
A: oo	A: 0 A: 1	A: 2 A: 1*
Three drives		
A: o B: o C: o	A: JBOD B: JBOD C: JBOD	A: 1 B: 1 C: 1
A: oo *o*	A: 0 A: 1/SBY	A: 2 A: 1**
A: ooo	A: 5 A: 0+1 A: 0	A: 2* A: 1.5* A: 3
Four drives		
A: o B: o C: o D: o	A: JBOD B: JBOD C: JBOD D: JBOD	A: 1 B: 1 C: 1 D: 1
A: oooo	A: 5 A: 0+1 A: 0	A: 3* A: 2* A: 4
A: ooo *o*	A: 5/SBY A: 0+1/SBY	A: 2** A: 1.5**

Table 2-7. Array Configuration Strategies *(Continued)*

Drives & Drive Groups	Possible RAID Levels	Effective Capacity
Five drives		
A: o	A: JBOD	A: 1
B: o	B: JBOD	B: 1
C: o	C: JBOD	C: 1
D: o	D: JBOD	D: 1
E: o	E: JBOD	E: 1
A: oooo	A: 5/SBY	A: 3**
o	A: 0+1/SBY	A: 2**
A: oo	A: 0	A: 2
B: oo	A: 1/SBY	A: 1**
o	B: 0	B: 2
	B: 1/SBY	B: 1**
A: ooooo	A: 5	A: 4*
	A: 0+1	A: 2.5*
	A: 0	A: 5
A: ooo	A: 5	A: 2*
B: oo	A: 0+1	A: 1.5
	B: 0	B: 2
	B: 1	B: 1*

Table 2-7. Array Configuration Strategies *(Continued)*

Drives & Drive Groups	Possible RAID Levels	Effective Capacity
Six drives		
A: o	A: JBOD	A: 1
B: o	B: JBOD	B: 1
C: o	C: JBOD	C: 1
D: o	D: JBOD	D: 1
E: o	E: JBOD	E: 1
F: o	F: JBOD	F: 1
A: oooooo	A: 5	A: 5*
	A: 0+1	A: 3*
A: ooooo	A: 5/SBY	A: 4**
o	A: 0+1/SBY	A: 2.5**
A: oooo	A: 5	A: 4*
B: oo	A: 0+1	A: 2*
	B: 0	B: 2
	B: 1	B: 1*
A: ooo	A: 5/SBY	A: 2**
B: oo	A: 0+1/SBY	A: 1.5**
o	B: 0	B: 2
	B: 1	B: 1*
A: ooo	A: 5	A: 2*
B: ooo	B: 5	B: 2*
	A:&B: 5+0	A:&B: 4**
	A: 0+1	A: 1.5*
	B: 0+1	B: 1.5*
	A:&B: 0+1+0	A:&B: 3**

Table 2-7. Array Configuration Strategies *(Continued)*

Drives & Drive Groups	Possible RAID Levels	Effective Capacity
Seven drives		
A: o	A: JBOD	A: 1
B: o	B: JBOD	B: 1
C: o	C: JBOD	C: 1
D: o	D: JBOD	D: 1
E: o	E: JBOD	E: 1
F: o	F: JBOD	F: 1
G: o	G: JBOD	G: 1
A: ooooooo	A: 5	A: 6*
	A: 0+1	A: 3.5*
A: oooooo	A: 5/SBY	A: 5**
o	A: 0+1/SBY	A: 3**
A: oooo	A: 5/SBY	A: 3**
B: oo	A: 0+1/SBY	A: 2**
o	B: 0	B: 2
	B: 1	B: 1**
A: ooo	A: 5/SBY	A: 2**
B: ooo	B: 5/SBY	B: 2**
o	A:&B: 5+0/SBY	A:&B: 4***
	A: 0+1/SBY	
	B: 0+1/SBY	A: 1.5**
	A:&B: 0+1+0/SBY	B: 1.5**
		A:&B: 3***

Table 2-7. Array Configuration Strategies *(Continued)*

Drives & Drive Groups	Possible RAID Levels	Effective Capacity
Eight drives		
A: o B: o C: o D: o E: o F: o G: o H: o I: o	A: JBOD B: JBOD C: JBOD D: JBOD E: JBOD F: JBOD G: JBOD H: JBOD I: JBOD	A: 1 B: 1 C: 1 D: 1 E: 1 F: 1 G: 1 H: 1 I: 1
A: oooooooo	A: 5 A: 0+1 A: 0	A: 7* A: 4 A: 8
A: ooooooo *o*	A: 5/SBY A: 0+1/SBY A: 0	A: 6** A: 3.5** A: 7
A: ooooo B: oo *o*	A: 5/SBY A: 0+1/SBY B: 0 B: 1/SBY	A: 4** A: 2.5** B: 2 B: 1**
A: ooo B: ooo *o o*	A: 5/SBY A: 0+1/SBY A: 0 A:&B: 5+0/SBY A:&B: 0+1+0/SBY B: 5/SBY B: 0+1/SBY	A: 2*** A: 1.5*** A: 3 A:&B: 4**** A:&B: 3**** 2*** 1.5***
A: oooo B: oooo	A: 5 B: 5 A:& B: 5+0 A: 0+1 B: 0+1 A:&B: 0+1+0 A: 0 B: 0	A: 3* B: 3* A:&B: 6** A: 2* B: 2* A:&B: 4* A: 4 B: 4
A: oooo B: ooo *o*	A: 5/SBY A: 0+1/SBY B: 5/SBY B: 0+1/SBY A: 0 B: 0	A: 3* A: 2* B: 2* B: 1.5* A: 4 B: 3

Chapter 3
Preparing the Array

Overview

The following is an overview of the steps necessary to prepare an array. Each step is described in greater detail later in this chapter.

1. **Start DACCF**
   Invoke DACCF from the MS-DOS prompt.

2. **Optimize the controller parameters for your application**
   Although the DAC960 ships from the factory optimized to work in a variety of environments, certain changes can be made to the controller's settings. This is the best time to make these optional changes.

3. **Low-level format the array's SCSI drives**
   It's a good idea to low-level format the SCSI drives with the DAC960 controller so that any media defects can be discovered and catalogued.

4. **Define and configure one or more physical drive groups or packs**
   Either use the automatic configuration option or define your own drive groups (also known as packs.) A drive group is a collection of one or more physical disk drives.

5. **Create and configure one or more system drives**
   A system drive has a defined capacity, RAID level, and write policy. Up to eight (or 32) system drives can be created for the entire array, depending on the firmware version. Maximum system drive size is 32GB (or 2 terabytes), also depending on the firmware version.

6. **Save the configured information**
   After configuring the array, save the configuration to the controller.

7. **Initialize the system drives**
   The final step is to initialize all of the system drives that have been configured above. Once this process is complete, the host operating system may be installed and the file system may be created on the array.

Navigating within DACCF

DACCF Screen Regions and Objects

You control DACCF via a text-based interface. Screen areas and objects that you'll encounter while using DACCF are shown in Figure 3-1 and explained below.

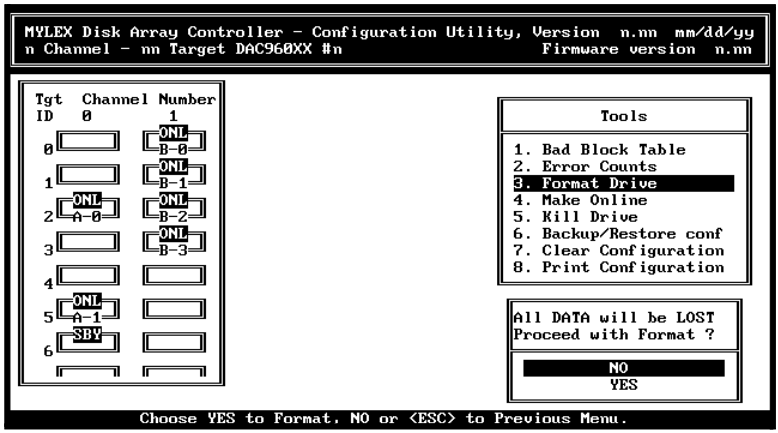


Figure 3-1. DACCF Screen Areas and Objects

Title Window

Throughout DACCF, a title window on the top of the screen will display the utility title, version number, and date (MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy). In addition, the currently selected controller's name, slot number, and firmware version are displayed (n Channel - nn Target DAC960XX #n Firmware version n.nn).

Actions Bar

Each screen uses the bottom row of the display to indicate allowed operator actions.

Menus and Dialog Boxes

Each screen has either a menu of items that can be selected, or a dialog box requiring a specific action.

Device Representations

At certain points in DACCF, a representation of a particular device (a disk array, for example) will be displayed along with a menu and/or dialog box. Often, DACCF permits you to navigate within the device to select specific objects (a disk drive, for example) upon which to perform specific operations. Navigation is normally performed via cursor keys or via a mouse, as outlined below.

Help Box

At key points throughout DACCF, a help box is displayed when a specific menu choice is highlighted. The Help box usually contains a textual description of the functions of the menu item. Help boxes are also displayed at strategic points throughout the program to inform you of actions that are not possible or that are forbidden. Help text is displayed brighter than normal dialog box text, and is framed by a double-line box.

Getting Around Within DACCF

Cursor Keys and Jump Keys

DACCF makes extensive use of the cursor movement keys on your keyboard (these are sometimes called arrow keys, and are labeled as ←↑↓→ on the keyboard) for menu navigation. These keys position a highlighted bar, called the cursor, on various items or objects of interest. If there are multiple possible selections available for a specific function that you want to perform, the cursor will only move between the valid choices, skipping all the invalid choices.

An alternative (and faster) method of positioning the cursor while in a menu is via the “Jump” keys. The jump key for any menu item is the single *number or character* which is displayed brighter than the surrounding text for that item. In the example shown in Figure 3-2, the jump keys are:

A, N, V, R, I, C, T, S, F, and D, (or 01 - 10)

When presented with any menu, type the jump key associated with a particular item to move directly to the item. The jump keys are case-insensitive.

Firmware versions above 2.6 allow for up to 15 target devices per channel, while versions at or below 2.6 allow for up to 8 target devices per channel. This difference is reflected in the number of target IDs available in the left-hand window. Use F2 followed by PgDn and PgUp to view additional devices on the channels.

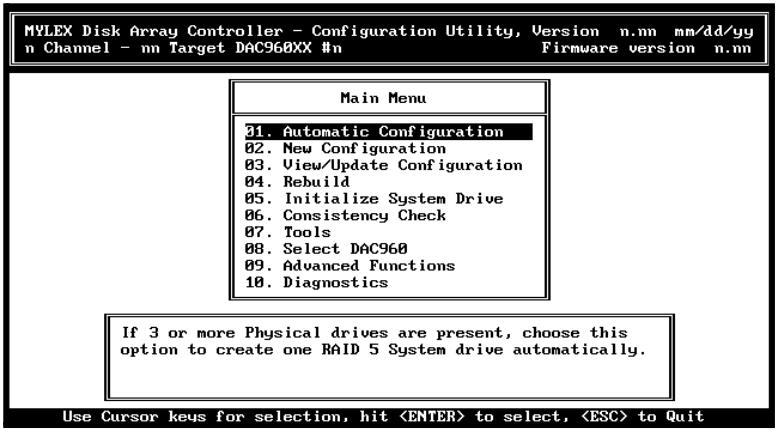

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
If 3 or more Physical drives are present, choose this option to create one RAID 5 System drive automatically.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 3-2. DACCF

Selecting an Item

Once highlighted via either of the above methods, an item is *selected* by pressing the Enter key.

Exiting a Menu

Use the Escape key (the key labeled ESC) to return to the previous action or state. For example, if you select the wrong menu choice, press the Esc key, and you will return to the original menu.

Using a Mouse

A mouse or other pointing device can also be used to navigate the DACCF menus. You'll need to have loaded a mouse driver prior to running DACCF. To position the highlight bar on a menu item, position the mouse cursor (as opposed to the highlighted bar) on the item and single-click the left mouse button. To select an item, position the mouse cursor on a highlighted item and single-click the left mouse button.

Starting DACCF

To start DACCF, type

```
A:\DACCF
```

at the MS-DOS command prompt, and press the Enter key.

Command Line Parameters

DACCF can be started with additional parameters. Appendix C contains an explanation of the most useful command line arguments which can be supplied.

Opening Screens

Normally, DACCF will locate the DAC960 Series controller and scan the SCSI device chains attached to it. During this process, a screen similar to Figure 3-3 will be displayed.

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Inquiring the devices connected to the adapter.
Channel # 0 Target ID 5
Initializing tables, please wait ...

Figure 3-3. SCSI Device Scan

This screen will be followed by the DACCF Main menu, as shown in Figure 3-4.

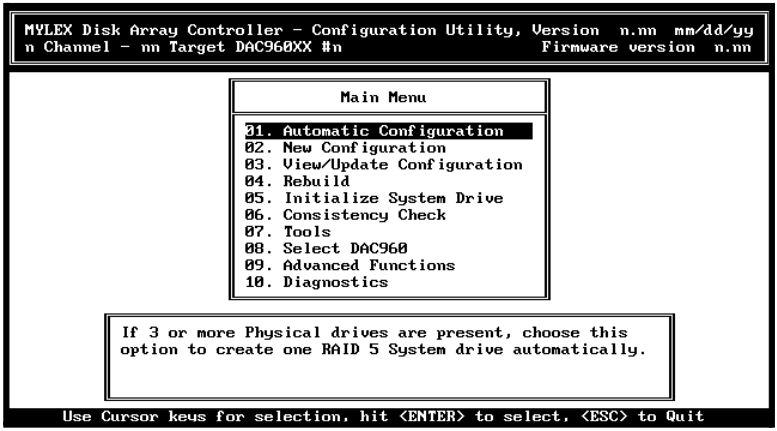

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
If 3 or more Physical drives are present, choose this option to create one RAID 5 System drive automatically.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 3-4. DACCF Main Menu

Problems?

If you do not see these two screens in succession, a problem may exist. Refer to Appendix D for more information on problems and how to resolve them.

Select DAC960

DACCF operates upon a single DAC960 Series controller at a time. If you have a single DAC960 Series controller in your system, DACCF will automatically detect and select it. You can ignore this section and proceed to “Set Controller Parameters for Your Application” on page 3-8.

If more than one DAC960 is detected in your system, DACCF will ask you which controller to perform operations upon (Figure 3-5).

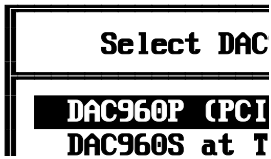


Figure 3-5. Select which DAC960 to operate upon

Select the desired controller, and after a brief interrogation of the devices attached to that controller, the Main menu (Figure 3-4) will appear.

To select a different DAC960 to perform operations upon:

1. Choose **Select DAC960** from the Main menu.
2. A list of controllers will appear. The currently selected controller will be highlighted.
3. Move the cursor to a different controller, and press the Enter key to select that controller. After a brief pause while the system interrogates the array, the Main menu will display.

Set Controller Parameters for Your Application

Each DAC960 Series controller is shipped from the factory with default settings which have been found to work well in a majority of applications and environments. However, no two environments are the same, and you may want to modify certain hardware settings before continuing with the preparation of your array. The most important parameters are explained below.

Controller parameters are set via the **Advanced Functions** option from the Main menu. See the section on Advanced Functions in Chapter 4.

Stripe Size

The stripe size is defined as the size, in kilobytes (1024 bytes) of a single I/O operation. A stripe of data (data residing in actual physical disk sectors, which are logically ordered first to last) is divided over all disks in the drive group.

Available stripe sizes are 8K, 16K, 32K, and 64K. For firmware versions below 2.6, the default stripe size for Mylex DAC960 Series controllers is 8K. For firmware versions at or above 2.6, the default stripe size is 64K.

Once set, the stripe size cannot be changed without first copying all of the data off of the array, changing the stripe size, reinitializing the drives, and copying the saved data back onto the array. In a large capacity array, this operation could take hours and inconvenience many people. You should evaluate your needs now and make any changes necessary *before* the array is placed in service.

Segment Size

DAC960 firmware version 2.6 and above includes an additional user-configurable parameter: segment size. Segment size is set in conjunction with stripe size and represents the size of the data “chunk” that will be read or written at one time. Under DACCF, the segment size (also known as “cache line size”) should be based on the stripe size you selected. Refer to Table 3-1 below for the available segment size settings to use for each stripe size. The default segment size for Mylex DAC960 Series controllers is 8K.

Table 3-1. Segment Sizes for Each Stripe Size

Stripe Size	Select Segment Size...
8K[a]	8K
16K	16K
32K	32K
64K[b]	1K 2K 8K[b] 64K

a. Default - Firmware version below 2.6
b. Default - Firmware version at or above 2.6

A large segment size (64K) is useful when accompanying a 64K stripe size for applications requiring large sequential reads or writes (such as video playback from disk). However, it can actually hinder system performance if files are smaller or if data access is more random than sequential. Small segment sizes (especially 8K) are best for most data processing situations.

Low-Level Format the Drives

Before starting the configuration for the first time, Mylex recommends that you low-level format the drives used in the array. Low-level formatting will completely erase any existing data on the drives and perform a media surface check. This procedure is described below.

WARNING

Low-level formatting will destroy any data on the disk drive.

Procedure

1. Select **Tools** from the Main menu (Figure 3-6).

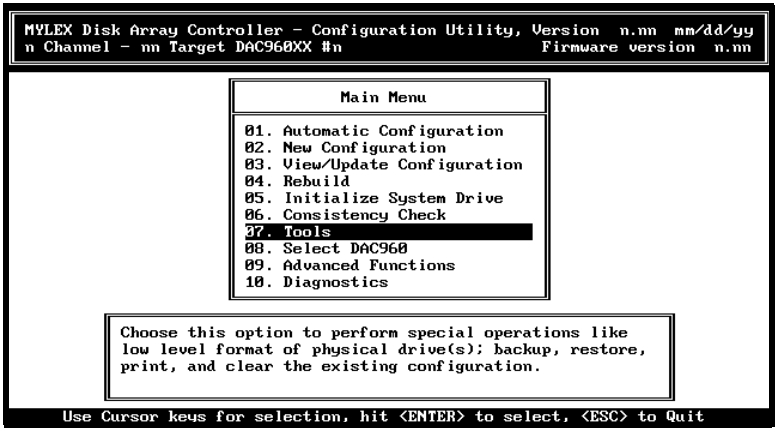

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to perform special operations like low level format of physical drive(s); backup, restore, print, and clear the existing configuration.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 3-6. Tools Option

The Tools menu will appear after a short interval (Figure 3-7).

A representation of the physical devices in the array will be displayed on the left side of the screen, and the Tools menu appears on the right side of the screen.

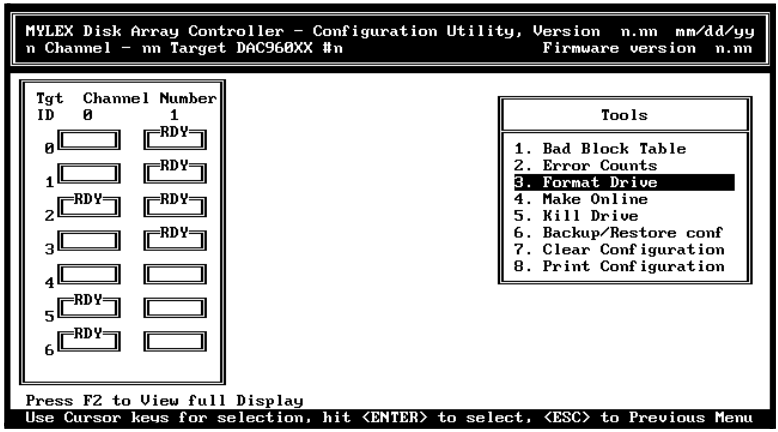

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Tgt ID
Channel Number
0 1
RDY
Tools
1. Bad Block Table
2. Error Counts
3. Format Drive
4. Make Online
5. Kill Drive
6. Backup/Restore conf
7. Clear Configuration
8. Print Configuration
Press F2 to View full Display
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 3-7. Tools menu

2. Select **Format Drive** from the Tools menu. The highlight bar will be positioned on the first device on the first channel of the array (Figure 3-8).

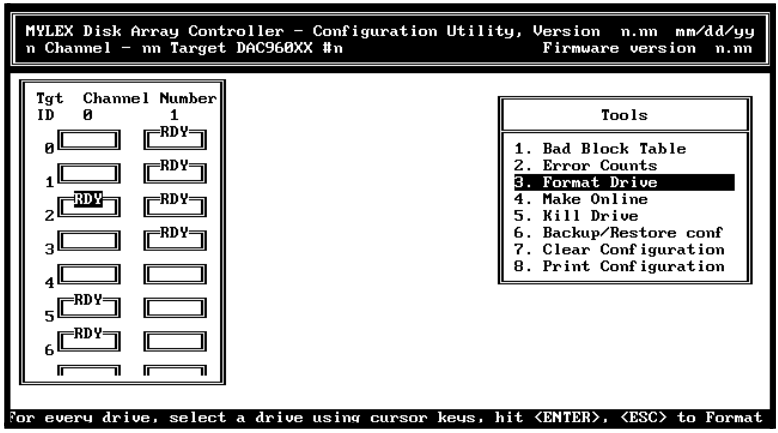

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Tgt ID
Channel Number
0 1
RDY
Tools
1. Bad Block Table
2. Error Counts
3. Format Drive
4. Make Online
5. Kill Drive
6. Backup/Restore conf
7. Clear Configuration
8. Print Configuration
For every drive, select a drive using cursor keys, hit <ENTER>, <ESC> to Format

Figure 3-8. Format Drive Selected

3. Select the drive to format by moving the highlight cursor to the desired drive and pressing the Enter key (Figure 3-9).

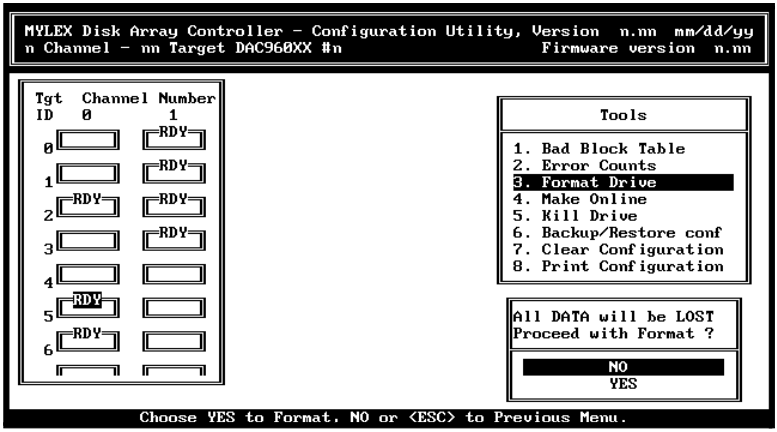


Figure 3-9. Selecting a Device to be Low-Level Formatted

4. A dialog box confirming the format operation will appear.
   - Select **YES** to include the drive in a format operation, and press the Enter key. The confirmation box will clear, and the drive state will change to **FMT** (Figure 3-10).
   - Select **NO** to exclude a drive which has been selected for formatting.

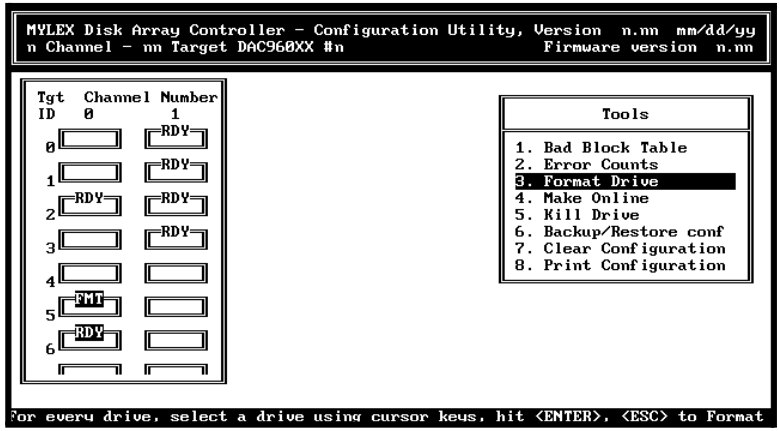


Figure 3-10. Device Selected for Low-Level Formatting

5. At this point, steps (3) and (4) can be repeated for other disk devices in the array that should be included in the low-level format.

6. After all devices have been selected for formatting, press the ESC key. A confirmation box will appear (Figure 3-11).

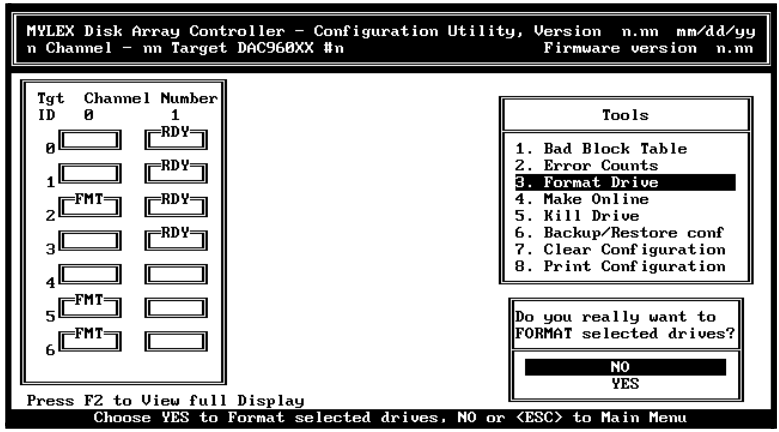


Figure 3-11. Device Format Confirmation

- Select **YES** to format the drives, and press the Enter key. The drive low-level format process will commence.
- Select **NO** to abort the format process, and press the Enter key. The

selected drives will not be formatted, and you will return to the Tools menu.

7. If a device cannot be low-level formatted, a message will appear (Figure 3-12) indicating the channel and ID of the device. The device should be replaced and the low-level format process repeated for that device.

Figure 3-12. Device Error During Format

8. To return to the Main menu from the Tools menu, press the ESC key.

Create the Drive Groups

After the devices have been formatted, the first step in configuration is deciding whether to configure drive groups automatically or manually. Automatic configuration has certain limitations (see "Automatic Configuration" below) but is the fastest way to prepare an array for operation. Manual configuration gives you complete control of the array's design, but will take longer to complete than an automatic configuration. Mylex recommends that you read both sections *before proceeding* to determine which method makes more sense for your installation.

Note: DAC960 Series controllers ship from the factory with *no* configuration information stored in memory.

Automatic Configuration

The Automatic Configuration option configures the array with just a few keystrokes, and can only be used when the array consists of between 3 and 8 drives. Although drives of different sizes may be used in the array, Automatic Configuration will only operate upon drives of the same physical size. The Automatic Configuration option creates an array with the following properties:

- All of the physical drives are contained in a single drive group;
- The drive group is defined as a single RAID level 5 system drive;
- Hot spare (standby) drive status (present or absent), and the write policy (write back or write through caching) is selected during the configuration process;
- The system drive number is 0.

Automatic Configuration Procedure

1. Select **Automatic Configuration** from the Main menu (Figure 3-13).

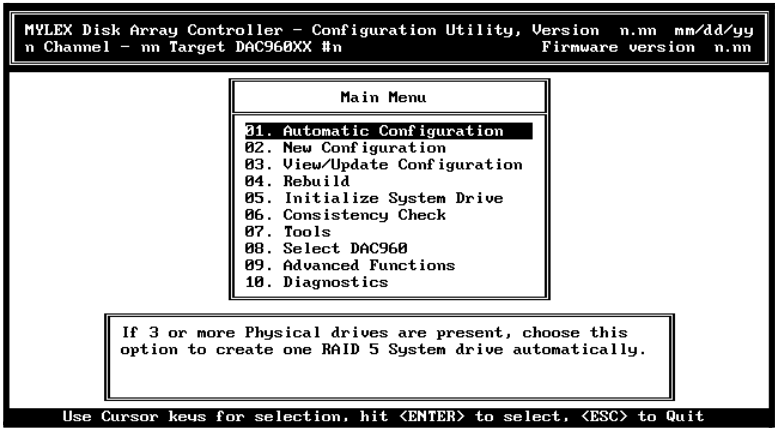

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
If 3 or more Physical drives are present, choose this option to create one RAID 5 System drive automatically.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 3-13. Automatic Configuration Option

2. An error message will be displayed if fewer than 3 or more than 8 drives are detected, or if drives of differing capacities are found. The Automatic Configuration will then abort, and an error message will appear (Figure 3-14.)

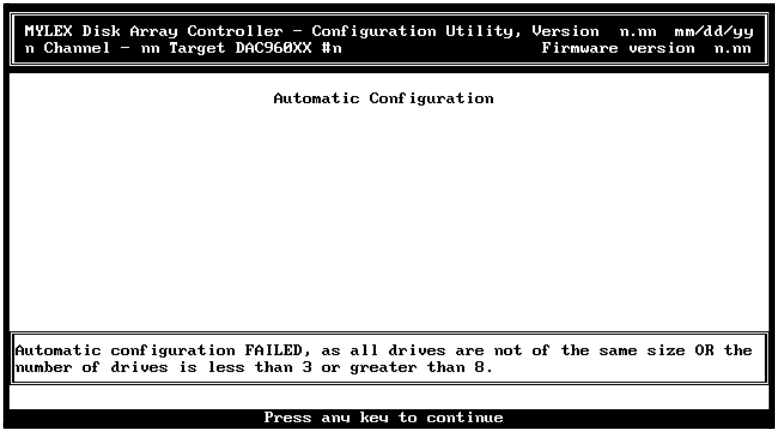

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Automatic Configuration
Automatic configuration FAILED, as all drives are not of the same size OR the number of drives is less than 3 or greater than 8.
Press any key to continue

Figure 3-14. Automatic Configuration Failure Message

3. If no errors are encountered, but a valid array configuration already exists, DACCF will warn you that you are about to replace the configuration with the structure created by the Automatic Configuration. A confirmation (Figure 3-15) is required to proceed.

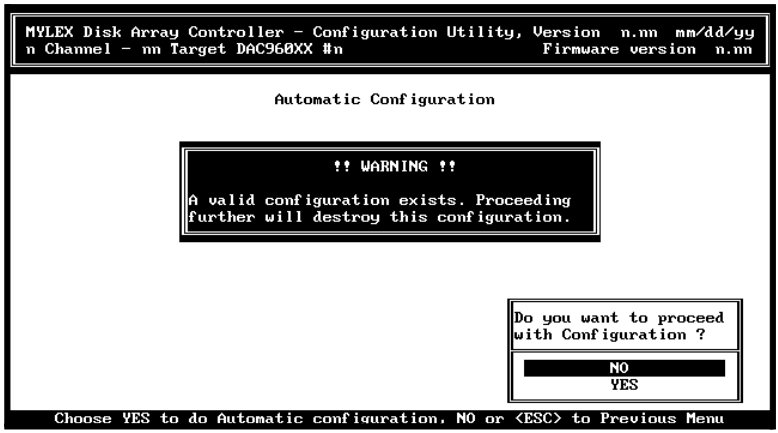

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Automatic Configuration
!! WARNING !!
A valid configuration exists. Proceeding further will destroy this configuration.
Do you want to proceed with Configuration ?
NO
YES
Choose YES to do Automatic configuration, NO or <ESC> to Previous Menu

Figure 3-15. Confirming Automatic Configuration

- Select **YES** to proceed, overwriting the existing configuration with the automatically generated configuration.
- Select **NO** in the confirmation box to return to the Main menu, with no changes to the array configuration.

4. Next, select whether you wish to reserve one available, unconfigured drive to be used as a hot spare (standby) drive (Figure 3-16).

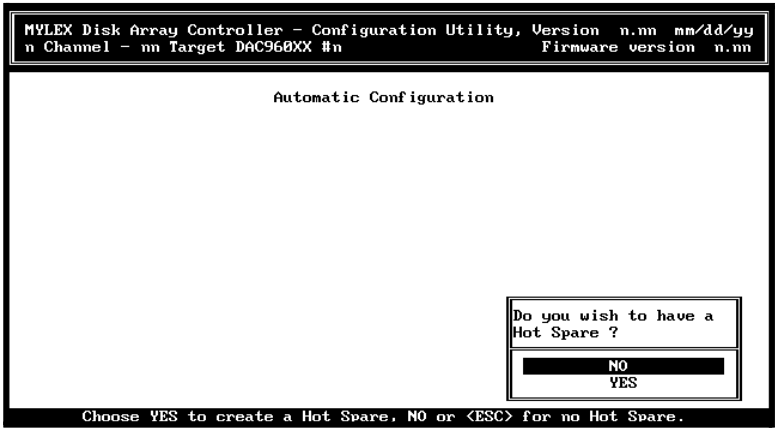

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Automatic Configuration
Do you wish to have a Hot Spare ?
NO
YES
Choose YES to create a Hot Spare, NO or <ESC> for no Hot Spare.

Figure 3-16. Deciding Whether to Reserve a Hot Spare

- Select **YES** to set aside one available drive to be used as a hot spare before all other drives are configured.
- Select **NO** to choose not to set aside a hot spare. Automatic Configuration will use *all* available drives to create the current configuration.

5. Next, select the write policy for the system drive that is to be automatically created (Figure 3-17).

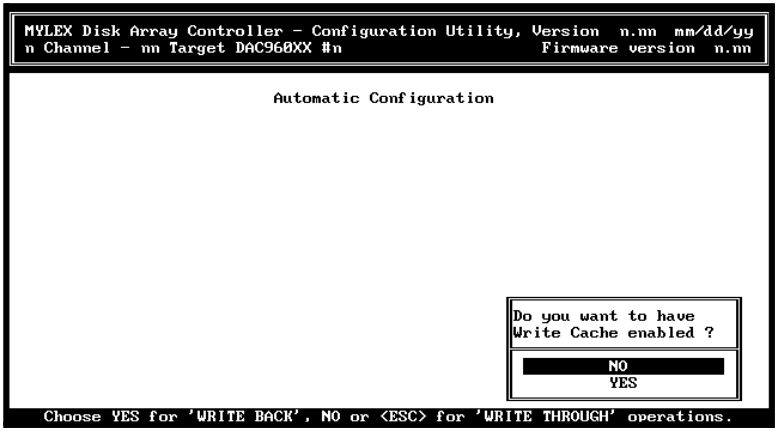

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Automatic Configuration
Do you want to have Write Cache enabled ?
NO
YES
Choose YES for 'WRITE BACK', NO or <ESC> for 'WRITE THROUGH' operations.

Figure 3-17. Selecting the Write Policy

- Select **NO** to set the write policy of the system drive to write through.

- Select **YES** to set the write policy to write back.

  Note: A *write back* policy (which stores data in the cache temporarily during a write operation) will result in better performance at the expense of potential fault tolerance. In the event of a power failure, any data in the cache will be lost, unless the cache has a battery backup. A *write through* policy (which writes data to the disk AND cache) will result in lower performance, but no data can be lost in the event of a loss of power. For more information about write policies, refer to the Glossary. *Mylex strongly recommends the use of a battery backup option or an uninterruptable power supply (UPS) with any disk array configured with the write back policy.*

6. Once the appropriate option is selected, the configuration is saved and a summary screen (Figure 3-18) is displayed. This summary screen displays the operating parameters for the configuration.

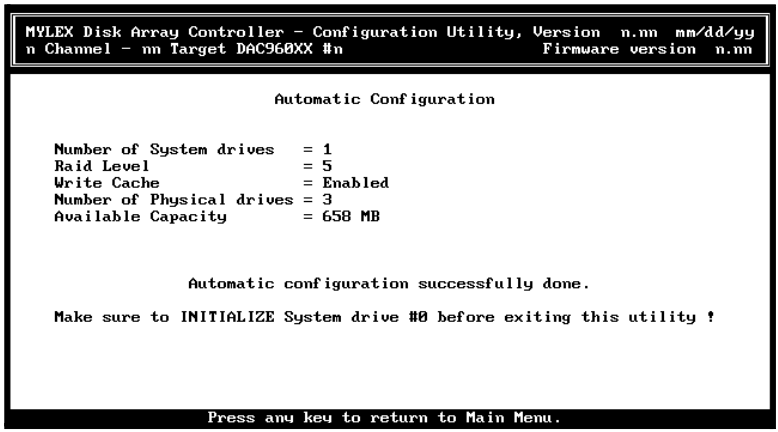

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Automatic Configuration
Number of System drives = 1
Raid Level = 5
Write Cache = Enabled
Number of Physical drives = 3
Available Capacity = 658 MB
Automatic configuration successfully done.
Make sure to INITIALIZE System drive #0 before exiting this utility !
Press any key to return to Main Menu.

Figure 3-18. Automatic Configuration Summary Screen

7. Press any key to return to the Main menu, and proceed directly to "Initialize the System Drives" on page 3-34.

New Configuration

Select this option to manually configure the disk array for the first time or to reconfigure the array. This option will create a new configuration, overwriting any existing array configuration. To change the write policy of an existing configuration or to add additional drive packs, use the **View/Update Configuration** item on the Main menu.

WARNING

Overwriting an existing configuration will result in the complete and *irreversible* loss of any data stored on disk drives in the array. Use this option with caution.

Define Drive Groups

To define drive groups, follow the procedure below:

1. Select **New Configuration** from the Main menu (Figure 3-19).

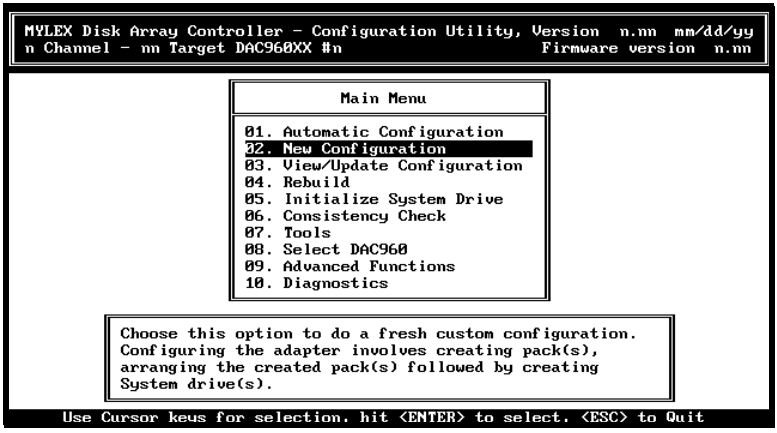

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to do a fresh custom configuration.
Configuring the adapter involves creating pack(s),
arranging the created pack(s) followed by creating
System drive(s).
Use Cursor keys for selection. hit <ENTER> to select. <ESC> to Quit

Figure 3-19. New Configuration Option

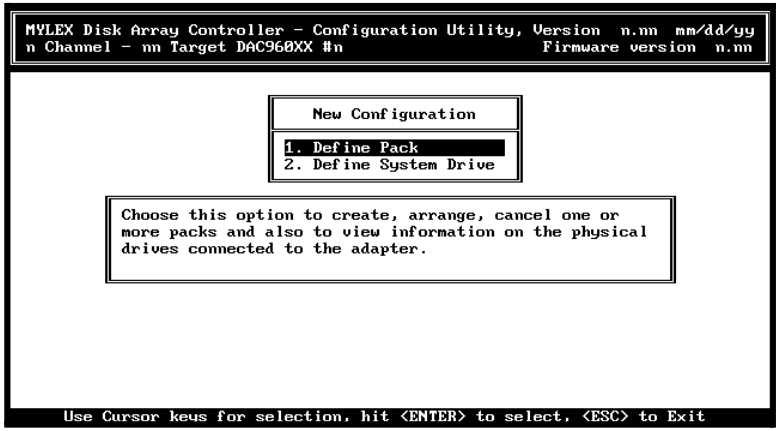

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
New Configuration
1. Define Pack
2. Define System Drive
Choose this option to create, arrange, cancel one or more packs and also to view information on the physical drives connected to the adapter.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Exit

Figure 3-20. New Configuration - Define Pack

2. Select **Define Pack** from the New Configuration menu (Figure 3-20). This option is used to define drive groups (also called packs).

   The Pack Definition menu will be displayed (Figure 3-21).

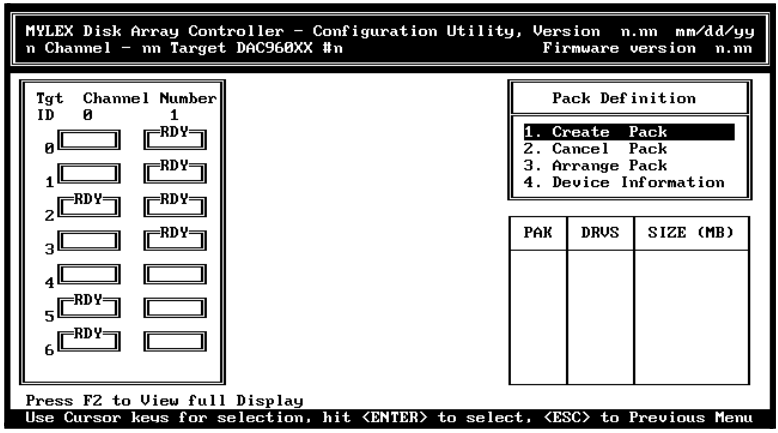


Figure 3-21. Pack Definition Menu

3. Select **Create Pack** to begin grouping the drives into a pack. The highlighted bar is positioned on the first device found by the controller on the first channel (Figure 3-22).

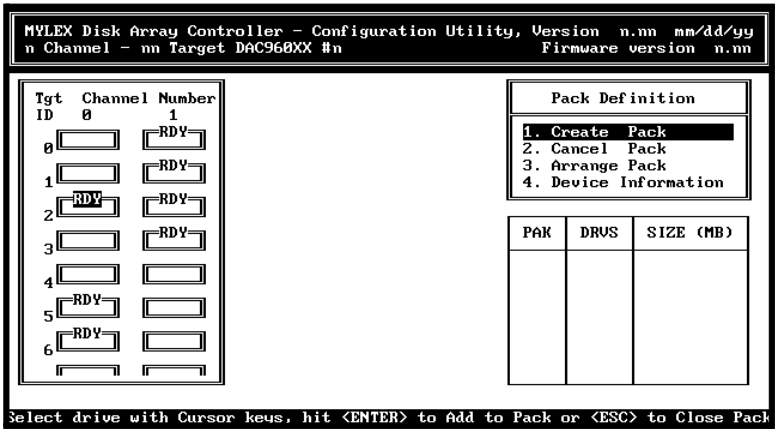


Figure 3-22. Creating a Drive Group

4. Use the arrow keys to position the highlighted bar on a disk device identified as **RDY**. (Device identification is shown in Table 3-2.)

Table 3-2. Device identification and status

Device Display	Device Status
RDY	Disk is operational, but not currently included in a drive group
DED	Disk is dead or has been manually taken offline
SBY	Disk is a hot spare (standby) drive
ONL	Disk is operational and is included in a group
FMT	Disk is being low-level formatted
WOL	Disk is part of a redundant drive group, and is in the process of being rebuilt from data and/or parity on other drives in the drive group.
UNF	Disk needs to be low-level formatted.
TAP	Device is a tape drive and will not be included in any DACCF operations.
CDR	Device is a CD-ROM drive and will not be included in any DACCF operations.

5. Press the Enter key to include it as part of the drive group. When a disk is selected for inclusion in a drive group, a pack identifier (A, B, C...) and disk index (0, 1, 2...) are assigned, and the disk status changes to **ONL** (Figure 3-23).

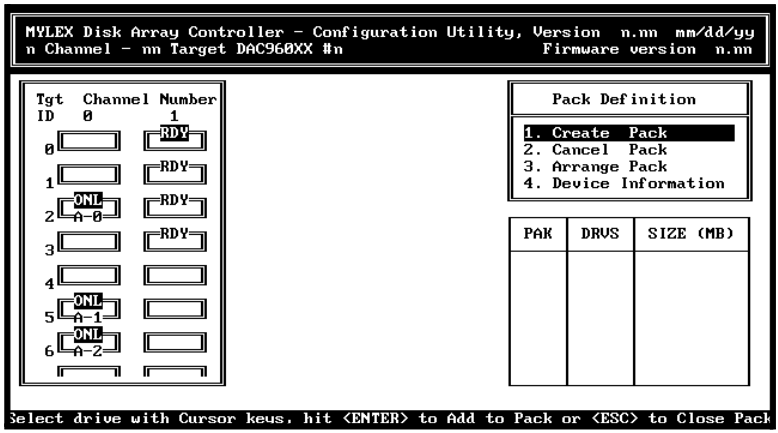


Figure 3-23. Devices with pack identifiers assigned

6. Repeat the previous two steps for as many drives as you want to include in a single drive group.

   Note: Drive groups can include disks on different channels, if the array has multiple channels and disks are connected to each channel. The number of drives in a drive group will determine the allowable RAID levels for all of the system drives created in that drive group. No more than eight physical drives can be included in a drive group. To use more than eight drives, create two groups that have an equal number of physical drives. Then arrange the drive groups (“Arrange the Drive Groups” on page 3-25) to use both drive groups in a single system drive.

7. To finish creating a drive group, press the ESC key. The device highlights disappear, but the pack identifier and disk index for each selected device remain (Figure 3-24). You will return to the Pack Definition menu.

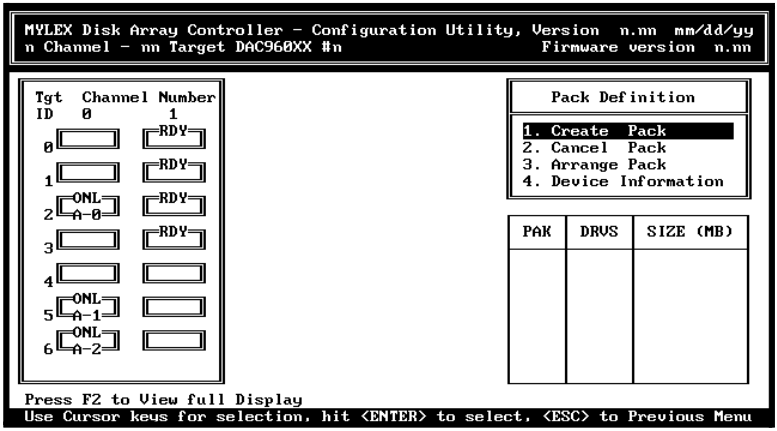


Figure 3-24. After creating a drive group...

8. Repeat steps 4-7 for as many drive groups as you wish to define.
   - To reserve a disk as a hot spare, do not include it in any packs.
   - Select **Cancel Pack** from the Pack Definition menu to release the drives in a pack, highlight any drive in the pack to be released, and press the Enter key.
9. When you have finished defining drive packs, press the ESC key to return to the Pack Definition menu.

   Note: If you have included all of the physical drives into a single drive group, the drive group will be automatically arranged and the System Drive Definition menu will appear, as shown in Figure 3-28. If this is the case, proceed to "Defining and Creating a System Drive" on page 3-27.

Change or Cancel a Drive Group

To change a drive group, you must first delete the drive group, and then re-create the group. To delete a drive group, select **Cancel Pack** from the Pack Definition menu.

Note: You can only cancel the most recently-created drive group. This means that if you've defined three drive groups, and then decide that you want to change the contents of the first drive group, you'll have to delete all three groups - the current, or third group, then the second group, and finally the first group. Before deleting any drive groups, though, you may want to write down the contents of the drive groups that you do not want to change. When you've changed the first group, you can then quickly recreate the second and third groups from your notes.

Create a Standby or Hot Spare disk

To create a standby, or hot spare drive, do not include the device as a part of any drive group. The device status will change from RDY to SBY when the configuration is saved to memory. Saving the configuration is explained later in this chapter.

Arrange the Drive Groups

Next, arrange the drive groups that you have created by selecting **Arrange Pack** from the Pack Definition menu. The pack arrangement screen will be displayed (Figure 3-25).

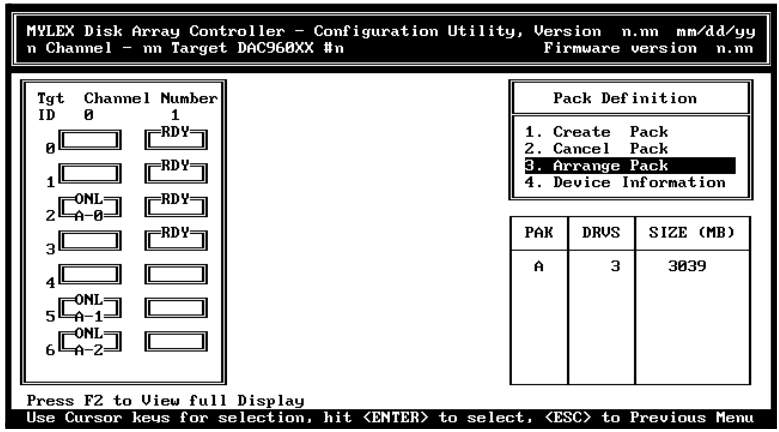


Figure 3-25. Arranging the Drive Groups

To arrange a drive group, move the highlighted bar to *any* drive of the desired group and press the Enter key to arrange it. The drive group will be added to the table on the lower right side of the screen, which lists the drive group's pack identifier, the number of drives in the group, and the capacity of the drive group. This table is called the pack arrangement table.

> **Note:** The drives belonging to unarranged packs, drives that are not part of any pack, or drives of arranged packs that have not been configured into any system drive will be automatically configured as standby drives.

If all of the packs are arranged, you will return to the New Configuration menu automatically.

Device Information

To obtain information about any physical disk drive connected to the DAC960 Series controller:

1. Select **Device Information** from the Pack Definition menu.
2. Using the cursor keys, select the device and press Enter. The selected drive's information is displayed in the lower right side (Figure 3-26).

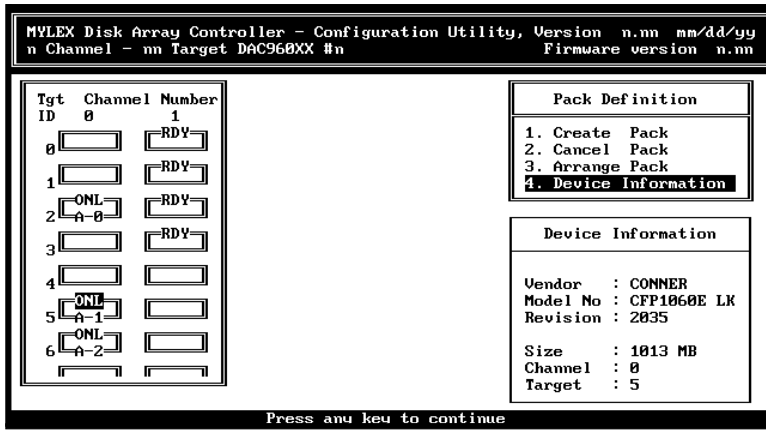


Figure 3-26. Getting Device Information

The device information window displays the device manufacturer, model number, firmware revision, and size as reported by the SCSI inquiry and read capacity commands. The channel to which the device is attached, as well as the SCSI ID of the device are also displayed.

3. To select another device, press any key to return to the drive matrix box, and repeat step (2) to select and display the properties of a different device.

4. To return to the pack definition menu, press the ESC key.

Defining and Creating a System Drive

After drive groups have been arranged, they are used to create system drives. System drives have the following properties:

- Each system drive has a defined capacity which is less than or equal to the total capacity of the drive group on which it resides.
- Maximum size of a system drive is 32GB when using DAC960 Firmware versions below 2.6, or 2TB (terabytes) when using firmware versions 2.6 and above;
- Up to eight (8) system drives can be created per controller with DAC960 Firmware versions below 2.6, up to 32 system drives for firmware 2.6 and above;
- Each system drive has a RAID level which is selectable (subject to the number of disks in the system drive's drive group);
- A system drive has selectable write policy: write-back or write-through.

Creating a System Drive

To create a System drive, follow these steps:

1. Select **Define System Drive** from the New Configuration menu (Figure 3-27).

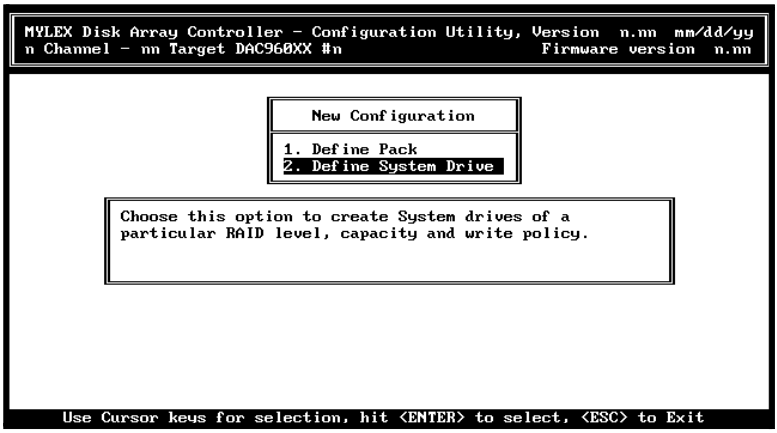

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
New Configuration
1. Define Pack
2. Define System Drive
Choose this option to create System drives of a particular RAID level, capacity and write policy.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Exit

Figure 3-27. New Configuration - Define System Drive

The System Drive Definition menu (Figure 3-28) will appear. This screen displays the existing arranged drive groups, System Drive Definition menu, and System Drive Table, which should be empty as there are no defined system drives. As system drives are defined, entries are added to this table.

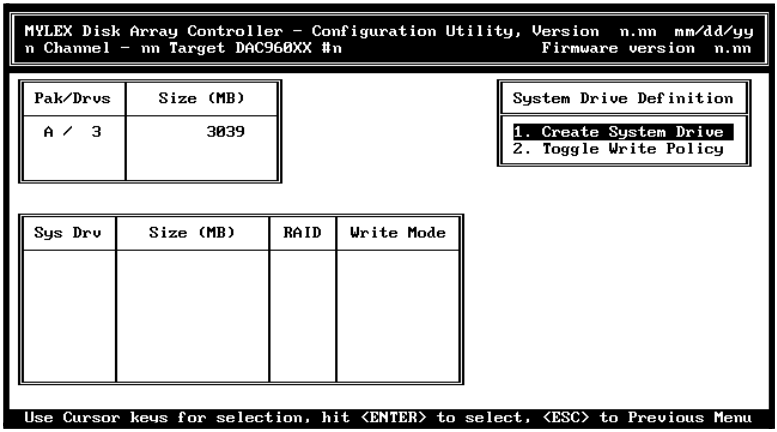

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Pak/Drvs
Size (MB)
A / 3
3039
System Drive Definition
1. Create System Drive
2. Toggle Write Policy
Sys Drv
Size (MB)
RAID
Write Mode
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 3-28. System Drive Definition Menu

2. Note that the size, as specified in the arranged pack table, will be the sum of the formatted capacity of the drives in the pack (see note below). The size, as specified in the system drive table, will be the actual size of the system drive, taking into consideration the RAID level and redundancy overhead. The size of the system drive is what the various operating systems will see and be able to use.

   Note: If the drives in a drive group are of different capacities, then the size of the entire pack is the product of the number of drives in the pack and the size of the *smallest* drive in the pack.

3. Select **Create System Drive** from the System Drive Definition menu. The first arranged pack is selected.

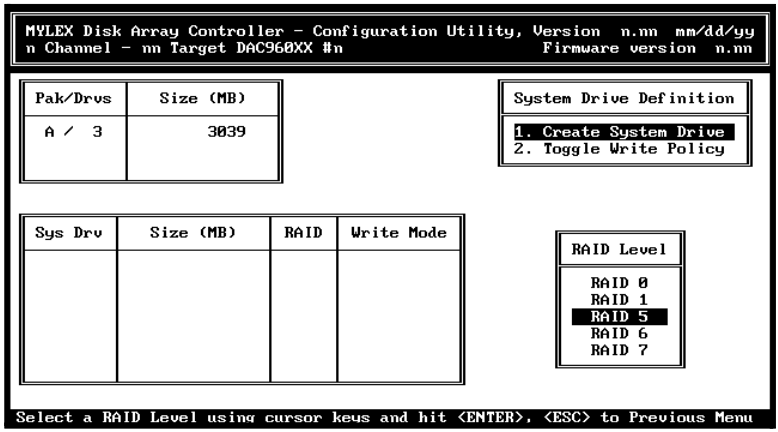


Figure 3-29. Selecting the RAID Level

4. The **RAID Level** selection menu pops up (Figure 3-29). Use the cursor keys to select a RAID level appropriate for the drive group. The cursor will only move to a valid RAID level allowed by the number of drives in the selected group. The number of drives in a drive group is also known as the stripe width of the drive group. Press the Enter key to select the RAID level for this system drive. Table 3-3 presents the minimum number of drives necessary to support each RAID level:

Table 3-3. Drives per drive group and supported RAID levels

Number of Drives	RAID Levels Available
1	Mylex RAID Level 7, also known as JBOD
2	0, 1
3 or more	0, 5, 0+1 (also known as RAID Level 6)

5. Define the size of this system drive in the **Enter Size (MB)** popup (Figure 3-30). By default, the maximum possible size for the system drive you're defining is displayed.
   - To accept the default capacity, press the Enter key.
   - To enter a value less than or equal to the default size, type the value and press the Enter key.

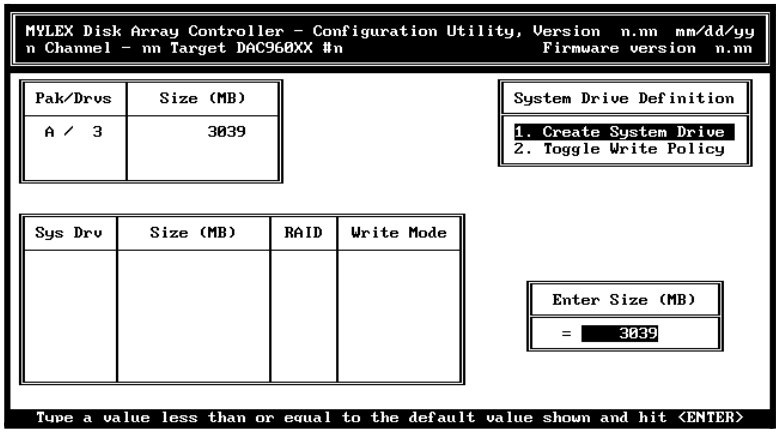

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Pak/Drvs
Size (MB)
A / 3
3039
System Drive Definition
1. Create System Drive
2. Toggle Write Policy
Sys Drv
Size (MB)
RAID
Write Mode
Enter Size (MB)
= 3039
Type a value less than or equal to the default value shown and hit <ENTER>

Figure 3-30. Entering the Size of the System Drive

6. A window with a summary of this system drive's settings and a confirmation dialog box is presented (Figure 3-31).

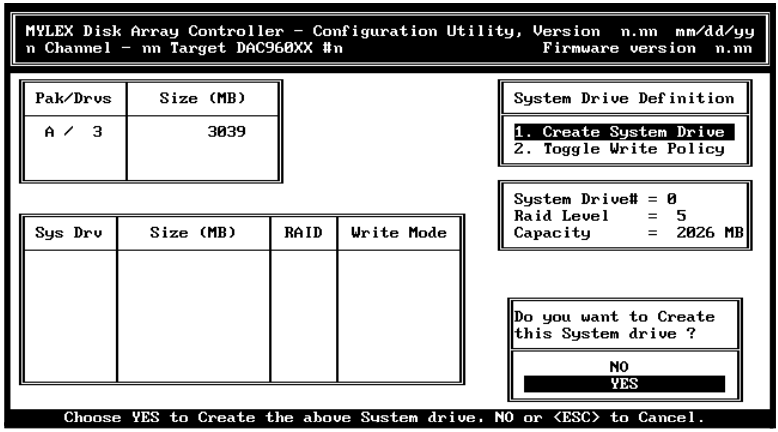


Figure 3-31. System Drive Summary

- Select **YES** to create the system drive and add it to the System Drive Table. The drive is added to the table and control is returned to the System Drive Definition menu.
- Select **NO** to cancel the creation of the system drive and return to the System Drive Definition menu,.

7. Repeat steps (2) through (6) to create additional system drives.

Note: Several arranged groups can be included in a single system drive if each of the arranged groups has the same number of drives. This is known as spanning a system drive across drive groups and is automatically configured when the size of the system drive is entered.

Toggle Write Policy

To change write policy (described earlier and also in the Glossary) of any system drive, use the following procedure:

1. Select **Toggle Write Policy** from the System Drive Definition menu (Figure 3-32). The cursor will move to the System Drive Table.

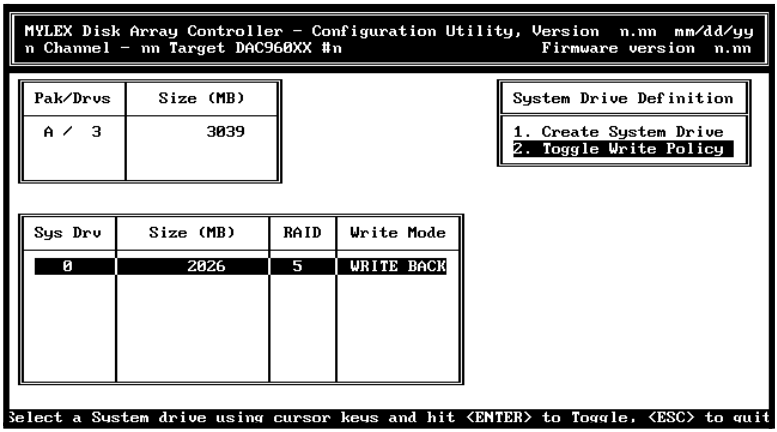


Figure 3-32. Selecting the Write Policy for a System Drive

2. Use the cursor keys to highlight the desired system drive.
3. Press the Enter key to toggle, or change the write policy for that system drive. The allowed policies are **WRITE THRU** and **WRITE BACK**.
4. Repeat steps (2) and (3) above to select and change write policies for other system drives (if any).
5. When the write policies are set correctly on all desired system drives, press the ESC key to return to the System Drive Definition menu.

Saving the New Configuration

Once all of the system drives are defined, the configuration should be saved to the DAC960 controller's memory. To save the configuration:

1. From the System Drive Definition menu, press the ESC key twice.
2. A confirmation dialog box will be displayed (Figure 3-33).

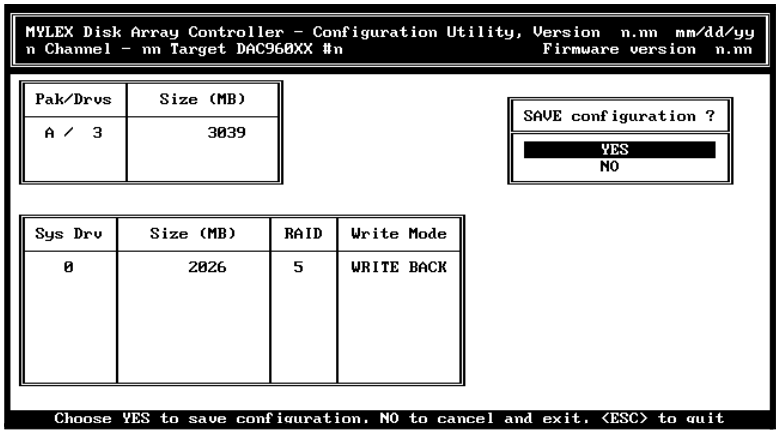


Figure 3-33. Save Configuration Dialog Box

- Select **YES** to save the configuration. You will return to the Main menu.
- Select **NO** to discard all changes made to drive groups, group arrangements, system drives and write policies. You will return to the Main menu.
- Press the ESC key to return to the New Configuration menu (Figure 3-20). Any changes are retained, and additional modifications can be made. However, the configuration will need to be saved before proceeding to the last step of array preparation.

This completes the configuration process. To finish preparing the array, initialize the system drives as described in the following section.

Initialize the System Drives

The last step in the preparation of the array is the initialization of the system drives. Mylex recommends that all system drives be initialized immediately after they are created.

WARNING

Failure to initialize a system drive will result in unpredictable drive behavior, such as an inability to boot or load the operating system, or failure of a consistency check. Any data placed on uninitialized system drives is at risk.

Initialization Procedure

To initialize one, several, or all (recommended) system drives, follow the steps below:

1. Select **Initialize System Drive** from the Main Menu (Figure 3-34).

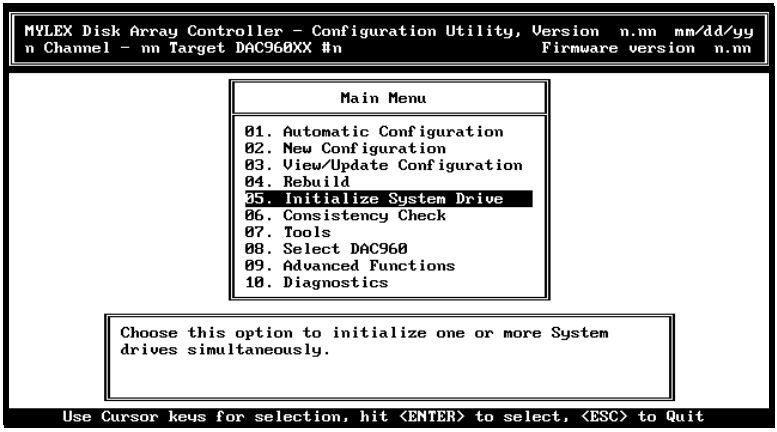

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to initialize one or more System drives simultaneously.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 3-34. Initialize System Drive Option

2. Choose **Select System Drive** from the Initialize System Drive menu (Figure 3-35).

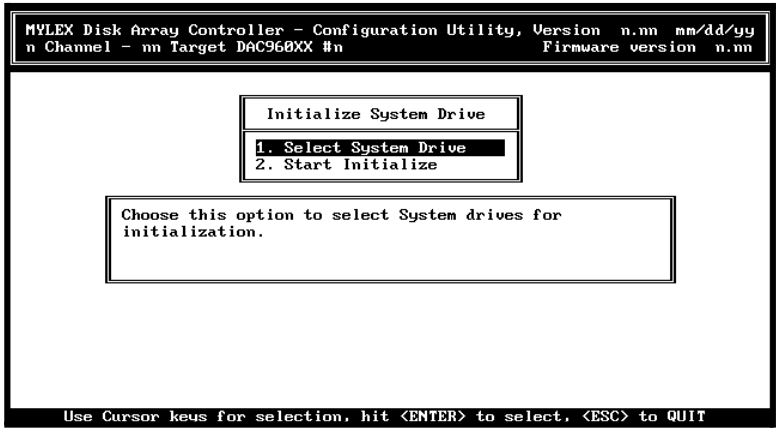

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Initialize System Drive
1. Select System Drive
2. Start Initialize
Choose this option to select System drives for initialization.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to QUIT

Figure 3-35. Initialize System Drive Menu

The Initialize System Drive screen will appear (Figure 3-36).

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Initialize System Drive
Sys Drv 0
Sys Drv 1
Simultaneous initialization of 8 System drives can be done. Using cursor keys, move to the required System drive box and hit <ENTER> to select.
!!WARNING: Initialization of the System drives WILL destroy data on the drives.
Select System drive(s) using cursor keys, hit <ENTER>, <ESC> to Previous Menu

Figure 3-36. Initialize System Drives

3. To mark a system drive for initialization, highlight a system drive (using the cursor keys or mouse) and press the Enter key. As multiple system drives can be initialized simultaneously, repeat this process until the desired system drives (again, all drives should be initialized) are marked with a check mark (Figure 3-37).

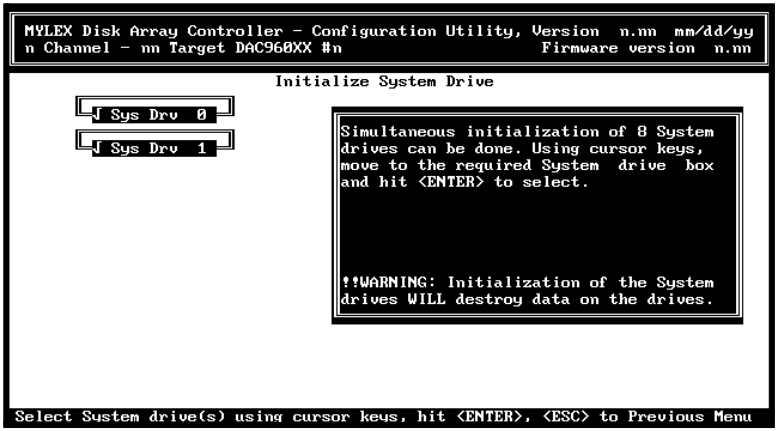

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Initialize System Drive
√ Sys Drv 0
√ Sys Drv 1
Simultaneous initialization of 8 System drives can be done. Using cursor keys, move to the required System drive box and hit <ENTER> to select.
!!WARNING: Initialization of the System drives WILL destroy data on the drives.
Select System drive(s) using cursor keys, hit <ENTER>, <ESC> to Previous Menu

Figure 3-37. All System Drives Selected

4. Press ESC to return to the Initialize System Drive menu (Figure 3-38).

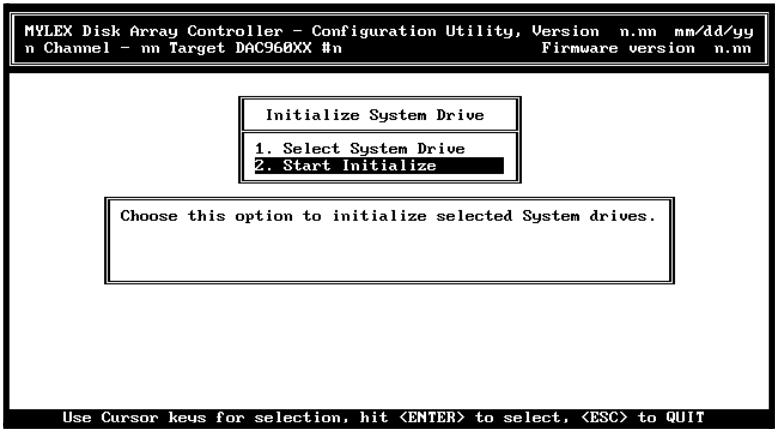

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Initialize System Drive
1. Select System Drive
2. Start Initialize
Choose this option to initialize selected System drives.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to QUIT

Figure 3-38. Return to the Initialize System Drive Menu

5. Select **Start Initialize** from the Initialize System Drive menu. A confirmation box (Figure 3-39) will appear.

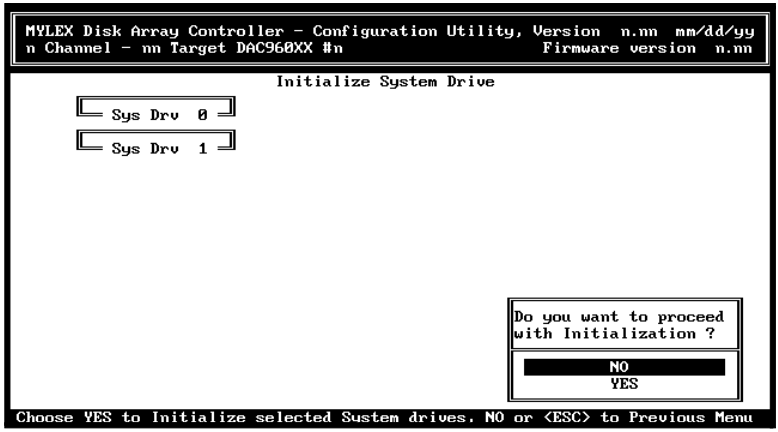

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Initialize System Drive
Sys Drv 0
Sys Drv 1
Do you want to proceed with Initialization ?
NO
YES
Choose YES to Initialize selected Sustem drives. NO or <ESC> to Previous Menu

Figure 3-39. System Drive Initialization Confirmation

Note: Once the system drive initialization is started, it cannot be aborted.

- Select **YES** to start the initialization of the selected system drives.
- Select **NO** to abort the process and return to the Initialize System Drive screen.

6. The initialization status screen (Figure 3-40) will be displayed, with the initialization progress of each drive included in the operation.

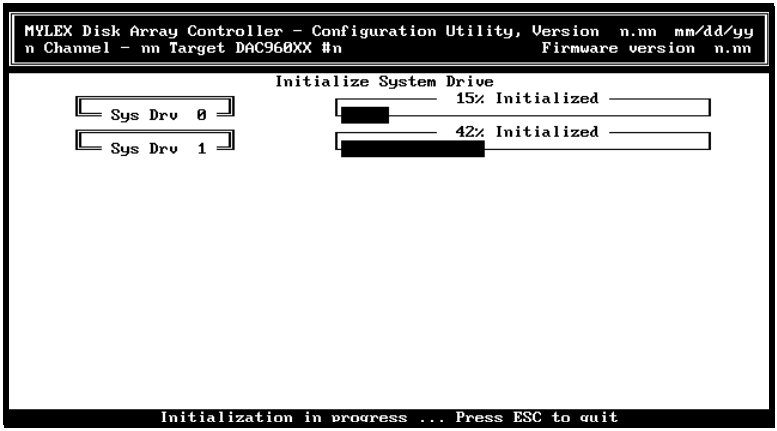

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Initialize System Drive
Sys Drv 0
15% Initialized
Sys Drv 1
42% Initialized
Initialization in progress ... Press ESC to quit

Figure 3-40. System Drive Initialization Status

Note: The initialization rate for a given system drive is dependent upon the size of the drive and the RAID level specified for the drive. Therefore, some system drives will initialize more quickly than others.

WARNING

Do not interrupt the initialization process.

7. At the conclusion of the initialization, a message (Figure 3-41) is displayed. Press any key to return to the Main menu.

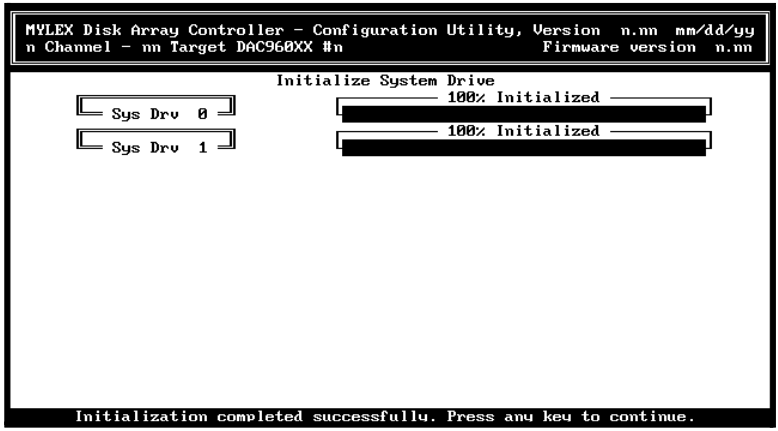

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Initialize System Drive
Sys Drv 0
100% Initialized
Sys Drv 1
100% Initialized
Initialization completed successfully. Press any key to continue.

Figure 3-41. After Initialization Has Finished...

Preparation of the array is complete at this point. You can exit DACCF at this time and proceed to load the operating system onto the array.

Exiting DACCF

To exit DACCF, follow these steps:

1. Get to the Main menu.
2. Press the ESC key. The Exit confirmation box will appear.
   - Select **YES** to exit DACCF and return to the MS-DOS command prompt.
   - Select **NO** to remain in DACCF.

Chapter 4
Administering the Array

Overview

During the operational life of the array, you may have a need to make additions or changes to certain properties of the configuration while retaining the existing configuration. For example, you may want to increase the capacity of the array, or create new system drives. Alternatively, you may want to change the write policy for a defined system drive. After a power or system failure, the data on the array's system drives should be verified and, if necessary, repaired. This section explains how to accomplish these and other tasks.

Viewing/Updating the Configuration

From the Main menu, use the View/Update Configuration option to view, edit or update an existing array configuration.

Select **View/Update Configuration** from the Main menu to perform any of the associated activities (Figure 4-1).

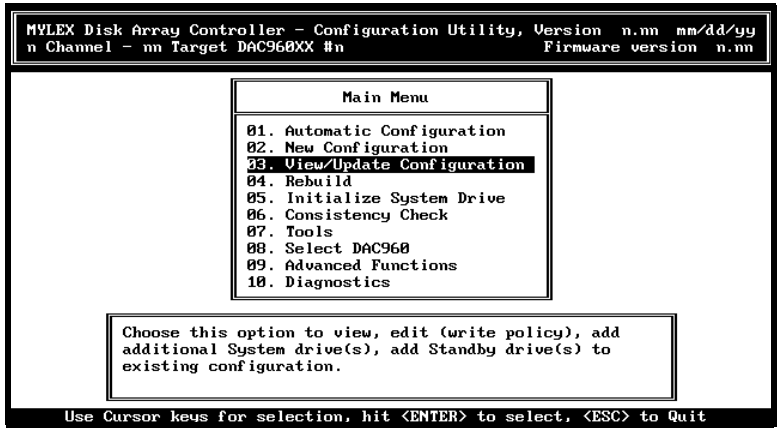

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to view, edit (write policy), add additional System drive(s), add Standby drive(s) to existing configuration.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 4-1. View/Update Configuration Option

The View/Update Configuration menu is displayed (Figure 4-2).

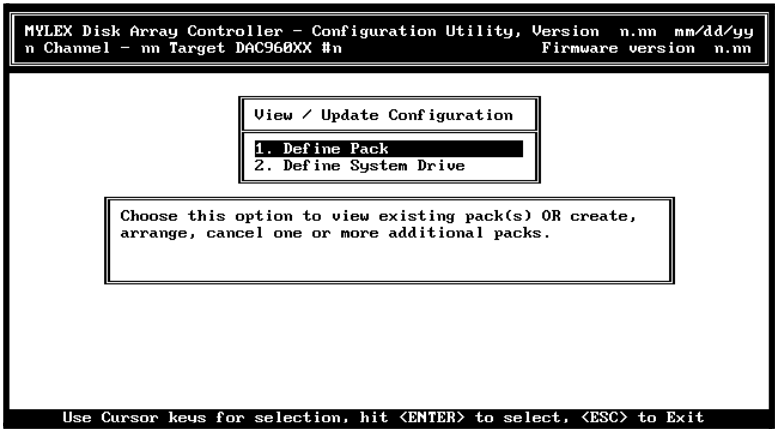

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
View / Update Configuration
1. Define Pack
2. Define System Drive
Choose this option to view existing pack(s) OR create, arrange, cancel one or more additional packs.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Exit

Figure 4-2. View/Update Configuration Menu

Use this option to make additions to the configuration, while *retaining* the existing configuration (and any data that is resident on system drives in the existing configuration.) The following functions are available:

- Change the write policy of any system drive from write back to write through (and vice versa). The write policy can be changed at any time.
- Create new standby drives. If new physical drives are being added, they can be designated as standby drives.
- Create new drive groups and system drives. Existing standby drives and new physical drives can be assigned to new drive groups for subsequent use in the definition of system drives.
- View the existing configuration. All array information, including drive groups, arranged groups, system drives, RAID levels, and write policies for system drives, is displayed.

> **Note:** Existing drive groups and system drives cannot be changed by using this function.

Changing the Existing Write Policy

To change an existing system drive's write policy, do the following:

1. Select **Define System Drive** from the View/Update Configuration menu. The System Drive Definition menu (Figure 4-3) will appear.

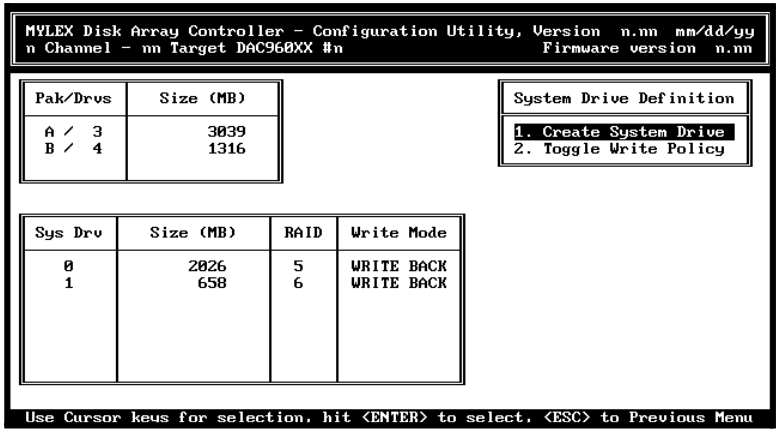


Figure 4-3. System Drive Definition Menu

2. Select **Toggle Write Policy** from the System Drive Definition menu (Figure 4-4).

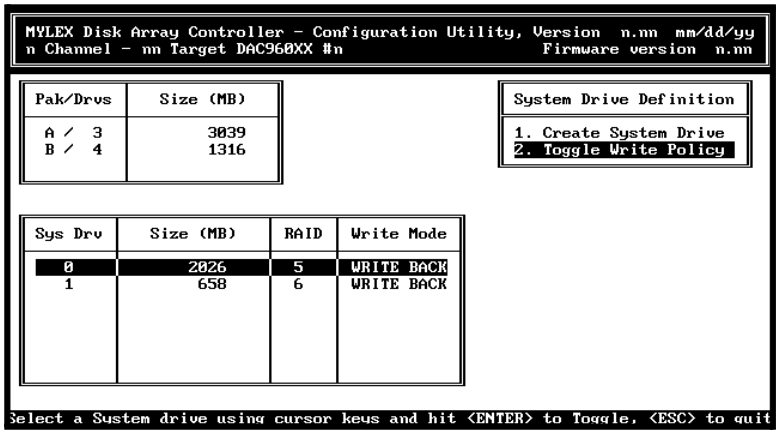


Figure 4-4. Selecting the Write Policy Option

3. The cursor will move to the system drive definition table.
4. Position the cursor on the system drive of interest, and press the Enter key to change the write policy for the selected drive.
5. Repeat step (4) above to select and change the write policy for other system drives.
6. Press the Esc key to return to the System Drive Definition menu.
7. Make other changes (as described below) or proceed to “Saving the Updated Configuration to Memory” on page 4-7.

Create New Standby Drives

To assign a new physical disk to standby (hot spare) status, do the following:

1. Ensure that the device has been low-level formatted, then select **Define Pack** from the View/Update Configuration menu.
2. Verify that the status of the new device has a status of RDY. If the status of a new device is set to UNF, the device requires low-level formatting, as described in the previous chapter.

   Note: In large configurations, multiple standby drives may be created for an extra level of protection.

3. When one or more physical disks has a status of RDY, press the ESC key to return to the View/Update Configuration menu (Figure 4-2).
4. Press the ESC key again. DACCF will notice drives available for standby duty and ask if you want to save the configuration (Figure 4-5).

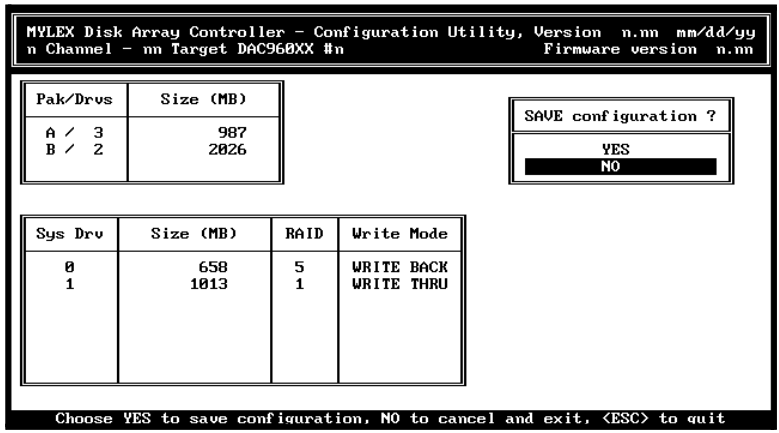


Figure 4-5. Save Configuration to Create Standby (Hot Spare) Drives

- Select **YES** to save a new configuration and create standby drive(s).
- Select **NO** to avoid creating the standby drive(s). The current configuration will be retained, and the drive(s) that are not part of a drive group will remain in the RDY state.

Create New Drive Groups and System Drives

To create new drive groups and system drives, do the following:

1. Select **Define Pack** from the View/Update Configuration menu.
2. Follow the instructions presented in “New Configuration” in the previous chapter. This includes creating and arranging drive groups, defining system drives, and setting RAID levels and write policy.

View the Existing Configuration

If no devices have been added to the array and no changes in write policy are planned, then navigation through either option of the View/Update Configuration menu is equivalent to viewing the configuration.

Saving the Updated Configuration to Memory

After making changes to write policy on existing system drives or creating new system drives, the configuration should be saved to the DAC960 controller's memory. To save the configuration:

1. From the System Drive Definition menu, press the Esc key twice.
2. A confirmation dialog box will be displayed (Figure 4-6).

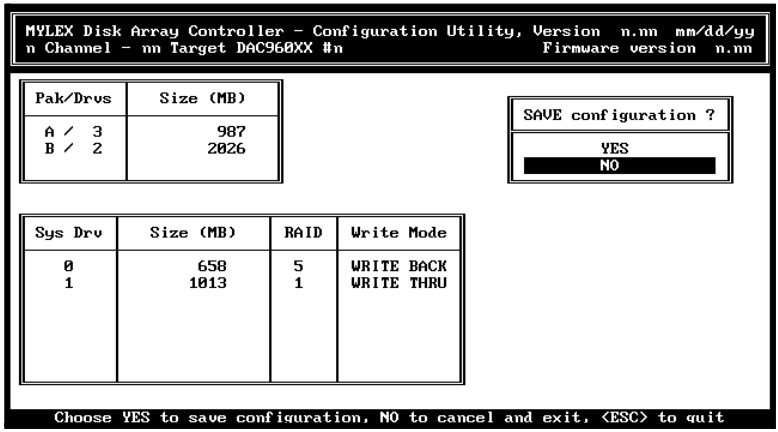


Figure 4-6. Saving the Updated Configuration

- Select **YES** in the dialog box to save the configuration, and you will return to the Main menu.
- Select **NO t**o discard all changes made to drive groups, group arrangements, system drives, and write policy, and you will return to the Main menu, or
- Press the ESC key to cancel the save process and return to the System Drive Definition menu. Any changes are retained, and additional modifications can be made. However, the configuration will need to be saved before proceeding to the last step of array preparation.

Rebuild Drives

If one of the physical drives fails suddenly in an array with redundant system drives (RAID level 1, 5, or 1+0) and no standby drives, the DAC960 system will continue to function without any interruption. However, during this critical period the DAC960 system can tolerate no further physical drive failures, as data on the drives is no longer redundant. During this period, the array is considered to be in a "Critical" state. In order to restore the system's redundancy (fault tolerance), the failed physical drive needs to be replaced with a functional physical drive of the same size and same SCSI ID, and the data needs to be "rebuilt" on this newly installed physical drive. Use the **Rebuild** option on the Main menu for this purpose.

> **Note:** Normally, a rebuild operation will also be supported by Mylex utilities for various operating systems and, as such, this DACCF option may not have to be used.

To rebuild a physical drive, do the following:

1. Select **Rebuild** from the Main menu (Figure 4-7).

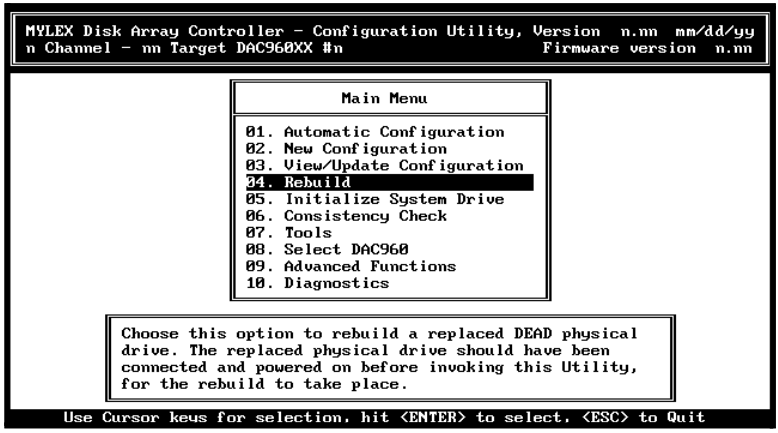

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to rebuild a replaced DEAD physical drive. The replaced physical drive should have been connected and powered on before invoking this Utility, for the rebuild to take place.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 4-7. Rebuild Option

2. The rebuild screen will be displayed, with the drive matrix on the left side of the screen (Figure 4-8).

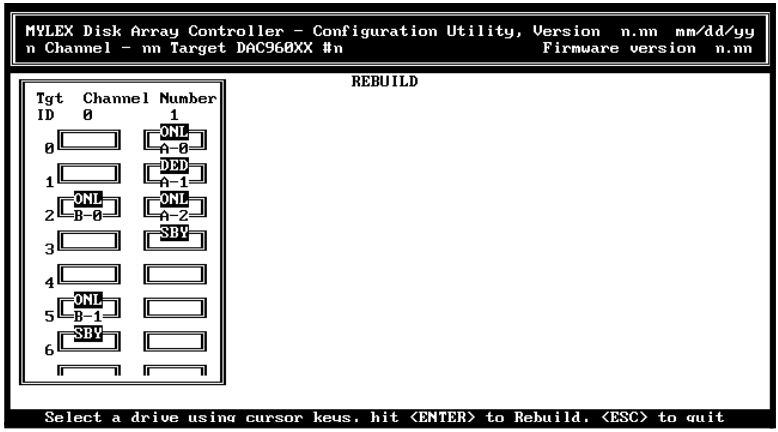


Figure 4-8. Drive Rebuild Screen

3. Using the cursor keys, select the drive to be rebuilt. Normally, the drive to be rebuilt will be indicated by the letters DED (for “DEAD drive”).

4. DACCF will ask you if you want to low-level format the drive (Figure 4-9).

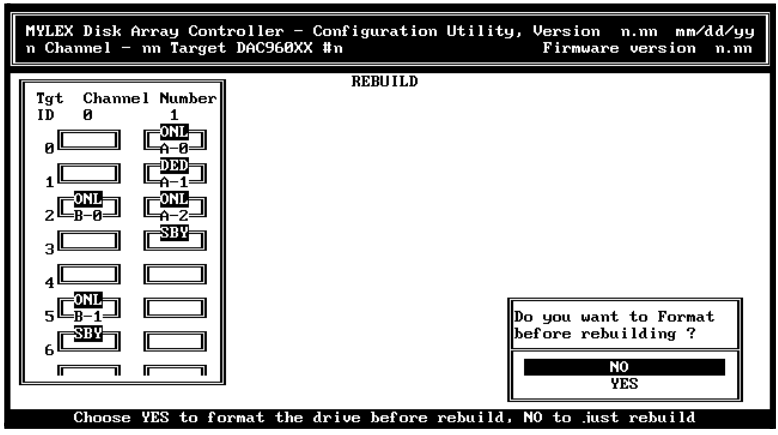


Figure 4-9. Format Before Rebuilding?

- Select **YES** if this is a new drive that has not been used in this array before (allow the drive to be low-level formatted before the rebuild takes place). Any defined system drives will then be rebuilt on the "new" drive in sequential order.
- Select **NO** to skip the low-level format and proceed directly to the rebuild of data on the "new" drive.

5. Press the Enter key to initiate the rebuild.
6. The rebuild status screen (Figure 4-10) will appear, showing the progress of data reconstruction on all of the system drives that are dependent on the selected physical drive. System drives are rebuilt sequentially, beginning with the system drive with the lowest numerical value.

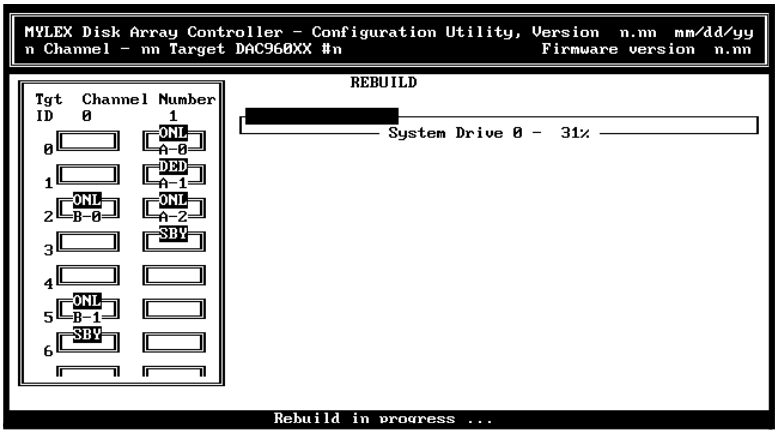


Figure 4-10. Rebuild Drive Status Screen

7. At the conclusion of the rebuild, a message indicating success will be displayed (Figure 4-11). Press any key to return to the Main menu.

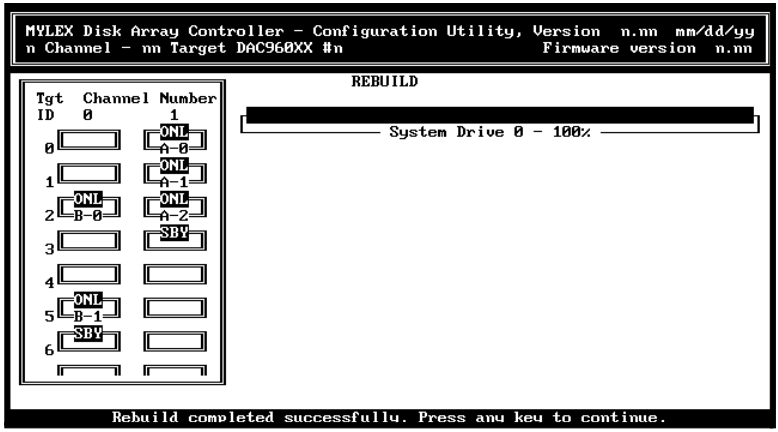


Figure 4-11. Rebuild Complete

Note: A rebuild fails if read errors are encountered on existing physical drives which comprise the system drive. The View Rebuild BBT function, “View Rebuild BBT” on page 4-41, reports all such errors.

Consistency Check

A consistency check compares the data and parity information on redundant system drives (e.g., system drives with RAID levels of 1, 5, or 0+1) to ensure that they can continue to function in the event of a physical drive failure. If a difference between the data and its generated parity is detected, the consistency check process can resolve the difference. Only one system drive may be checked at a time for consistency.

WARNING

Restoring consistency could mean loss of data in the blocks that were found inconsistent, resulting in data corruption and/or loss of data. Use the consistency check with caution.

To verify (and if necessary, correct) the integrity of a particular *redundant* system drive, do the following:

1. Select **Consistency Check** from the Main menu (Figure 4-12).

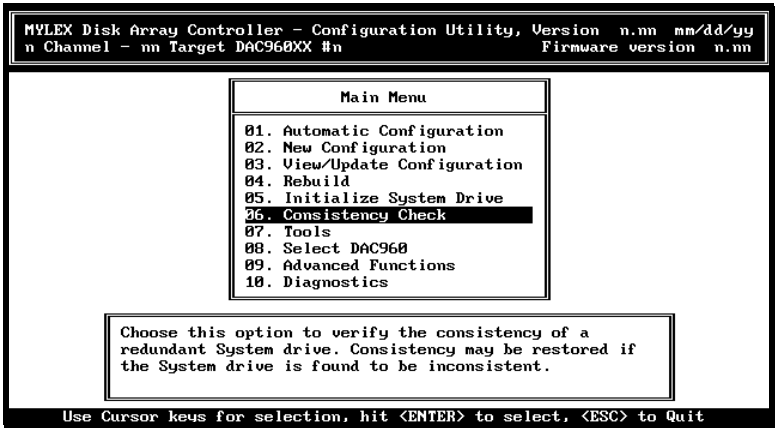

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to verify the consistency of a redundant System drive. Consistency may be restored if the System drive is found to be inconsistent.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 4-12. Consistency Check Option

2. Choose **Select System Drive** from the Consistency Check menu (Figure 4-13).

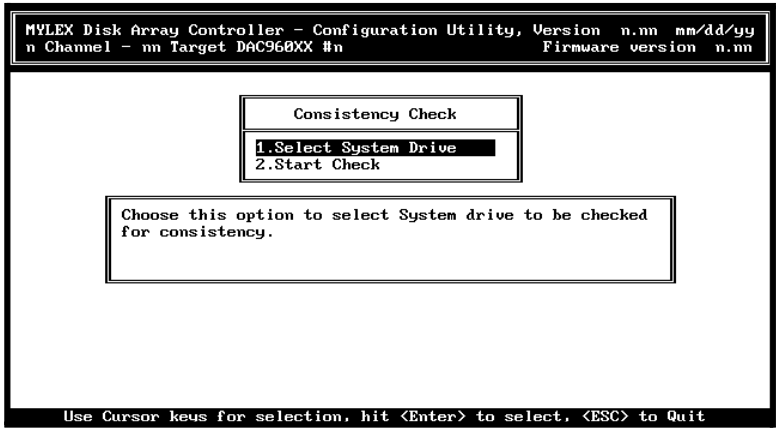

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Consistency Check
1.Select System Drive
2.Start Check
Choose this option to select System drive to be checked for consistency.
Use Cursor keys for selection, hit <Enter> to select, <ESC> to Quit

Figure 4-13. Consistency Check Menu

The Consistency Check screen will appear (Figure 4-14).

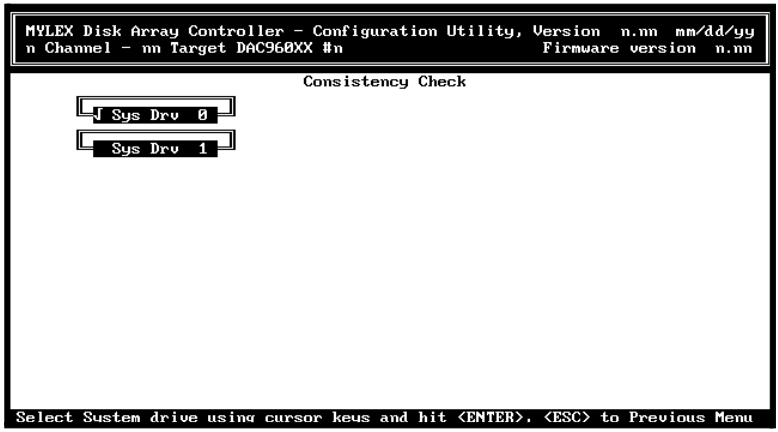

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Consistency Check
Sys Drv 0
Sys Drv 1
Select System drive using cursor keys and hit <ENTER>, <ESC> to Previous Menu

Figure 4-14. Consistency Check

3. Use the cursor keys to select a particular redundant system drive to be checked for consistency.

Note: Selecting a non-redundant system drive for a consistency check will result in an error message, as such drives cannot be checked in this manner.

4. Press ESC to return to the Consistency Check menu (Figure 4-15).

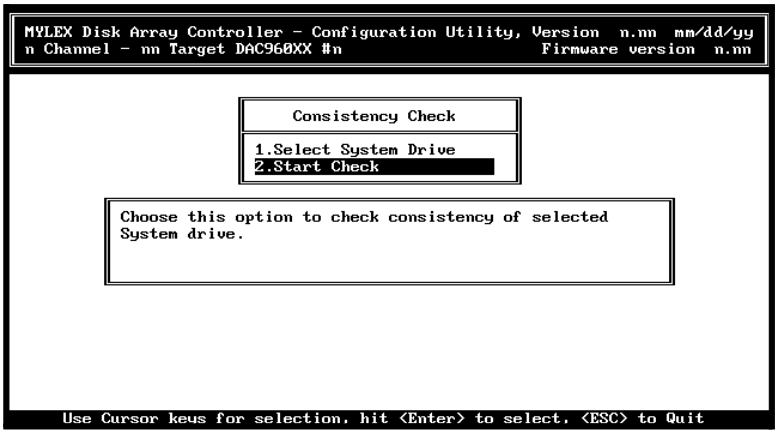

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Consistency Check
1.Select System Drive
2.Start Check
Choose this option to check consistency of selected System drive.
Use Cursor keys for selection, hit <Enter> to select, <ESC> to Quit

Figure 4-15. Return to the Consistency Check Menu

5. Select **Start Initialize** from the Consistency Check menu.

6. A confirmation box will appear, asking if you want to automatically restore consistency to the drive (Figure 4-16).

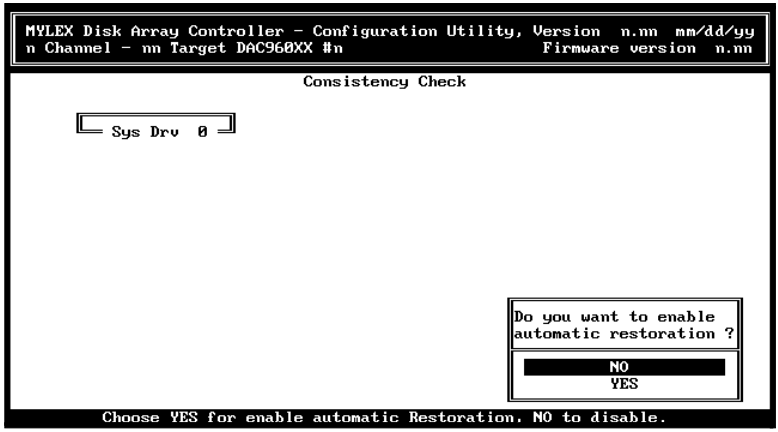

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Consistency Check
Sys Drv 0
Do you want to enable automatic restoration ?
NO
YES
Choose YES for enable automatic Restoration. NO to disable.

Figure 4-16. Automatic Restoration of Consistency to Drive?

- Select **YES t**o restore consistency to the selected system drive. Be aware that potential *data loss* could result from this action.
- Select **NO** to cancel the restoration of consistency between the data and parity information contained on this system drive. If you are unsure that you have a backup copy of the data on this system drive, select the **NO** option, make a backup of the information on the system drive, and then perform the consistency check.

7. Press the Enter key to start the process.

8. The consistency check status screen (Figure 4-17) will appear, showing the status of the operation.

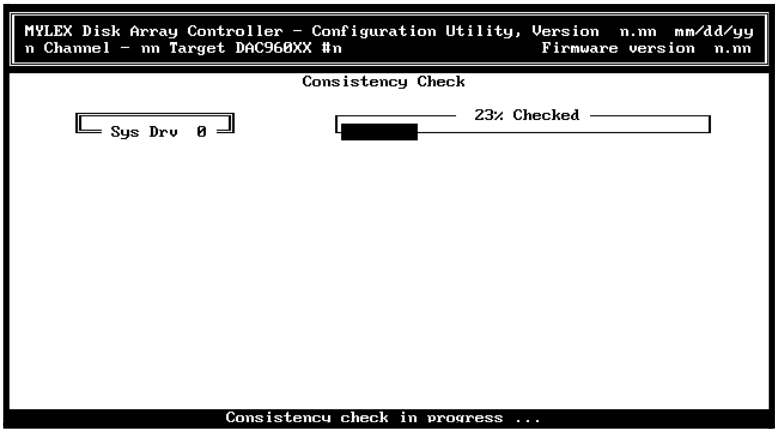

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Consistency Check
Sys Drv 0
23% Checked
Consistency check in progress ...

Figure 4-17. Consistency Check Status Screen

9. At the conclusion of the check, a message indicating success will be displayed (Figure 4-18). Press any key to return to the Main menu.

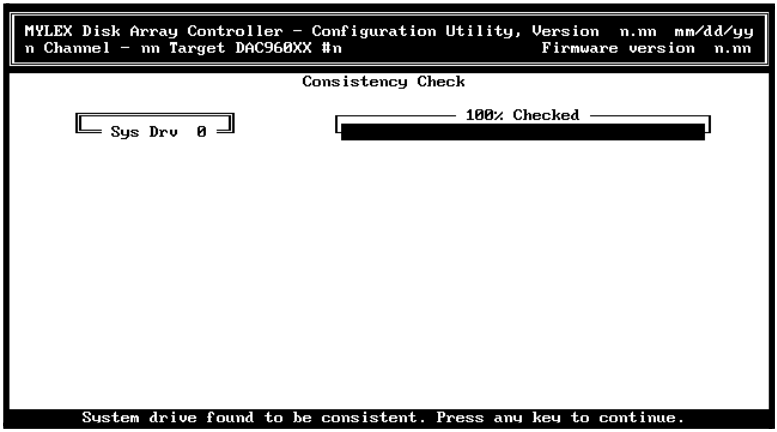

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Consistency Check
Sys Drv 0
100% Checked
System drive found to be consistent. Press any key to continue.

Figure 4-18. Consistency Check Complete

Configuration Management

The configuration of your array (disks, drive groups, RAID levels, as well as other parameters) is stored in two memory locations on the DAC960 controller. However, Mylex recommends that you make a backup copy of the configuration to diskette and store the diskette in a safe place. If necessary, a new array can be completely configured by restoring the backup configuration from the diskette.[1]

Note: Any errors encountered in reads or writes to the disk during a backup, restore or print configuration process will result in the message, “Retry or abort.” Choosing **abort** will exit DACCF.

1. Recommended if using DAC960 firmware versions below 3.0. Firmware version 3.x employs “configuration-on-disk” and does not require manual backup and restore.

Backup/Restore Configuration

Note: *USERS OF DAC960 FIRMWARE VERSION 3.0 AND ABOVE* may skip this section. The "configuration-on-disk" feature of firmware version 3.0 and above automatically saves the current configuration to the disk drives without user intervention. Should a controller fail, the saved configuration is restored to the new controller from the information contained on the drives. In most cases, manual backup/restore should not be used!

USERS OF DAC960 FIRMWARE VERSION 2.6 OR BELOW must perform manual backup and restore as described below.

To backup or restore a configuration, do the following:

1. Select **Tools** from the Main menu (Figure 4-19).

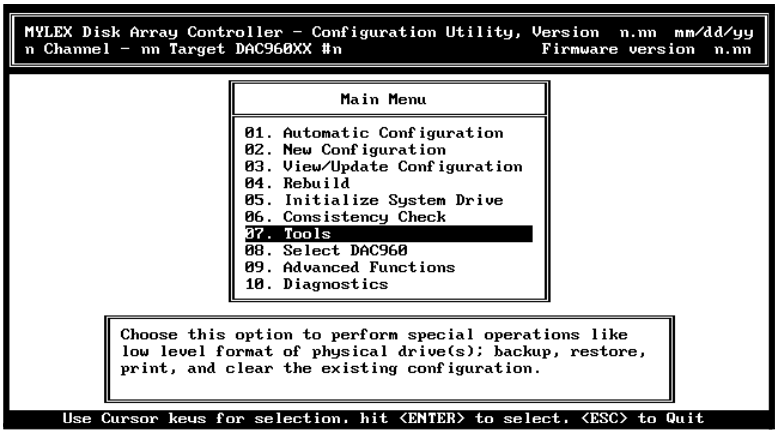

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to perform special operations like low level format of physical drive(s); backup, restore, print, and clear the existing configuration.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 4-19. Tools Option

2. Select **Backup/Restore conf** from the Tools menu (Figure 4-20).

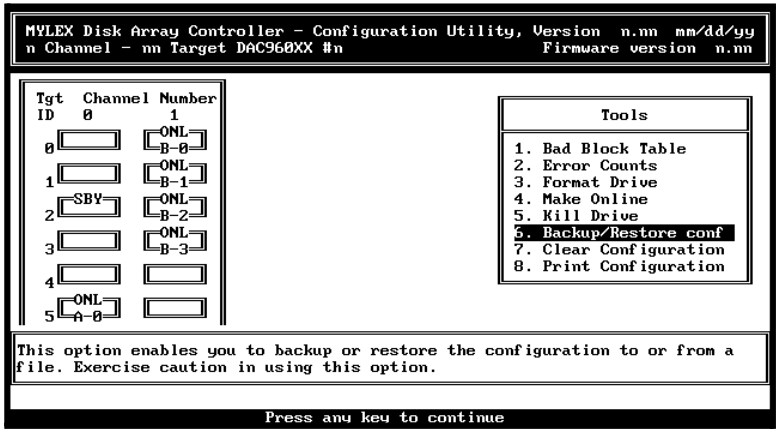

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Tgt ID
Channel Number
0 1
0 ONL B-0
1 ONL B-1
2 SBY ONL B-2
3 ONL B-3
4
5 ONL A-0
Tools
1. Bad Block Table
2. Error Counts
3. Format Drive
4. Make Online
5. Kill Drive
6. Backup/Restore conf
7. Clear Configuration
8. Print Configuration
This option enables you to backup or restore the configuration to or from a file. Exercise caution in using this option.
Press any key to continue

Figure 4-20. Configuration Management Warning

3. A message warning you to exercise caution when using this utility will appear. Press any key to continue.

4. The Backup/Restore Conf (Configuration) menu appears in the lower right corner of the screen (Figure 4-21).

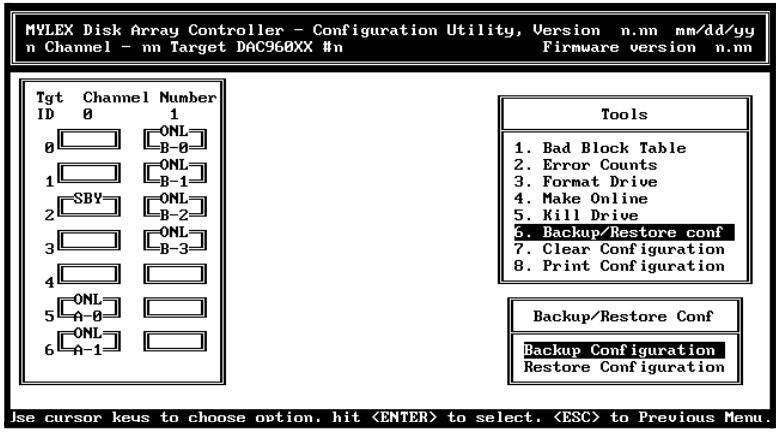


Figure 4-21. Backup/Restore Conf Menu

Backup Configuration

1. Select the **Backup Configuration** option to back up the current DAC960 configuration to a file on a disk. You'll be prompted to specify the name and location of the backup file (Figure 4-22). The filename can be up to 10 characters, including the drive prefix. Avoid using full pathnames. Mylex suggests that you name the file so that you can easily recognize it when you need it; for example, RAID.CNF or ARRAY.CNF.

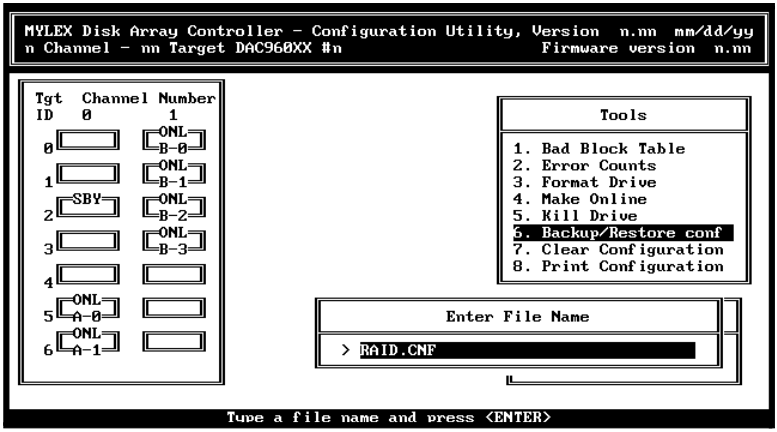


Figure 4-22. Specify a File Name for Backup of the Configuration

2. Enter the name of the file and press the Enter key. A confirmation box (Figure 4-23) will appear.

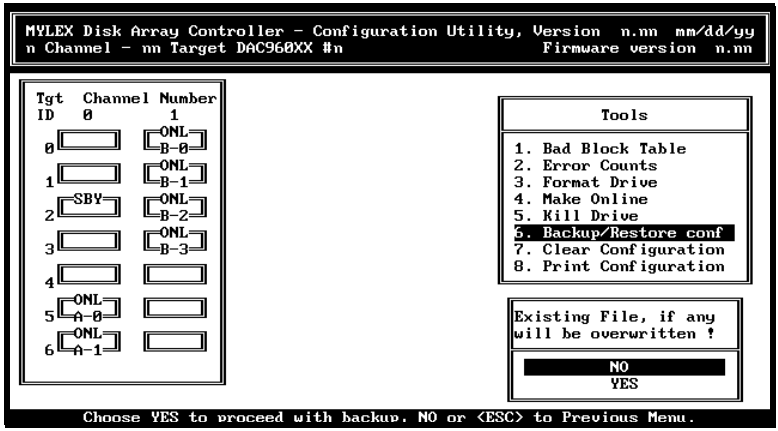


Figure 4-23. Backup Confirmation

- Select **YES** to proceed with backup of the configuration. The configuration will be copied to disk.

WARNING

If a file of the same name already exists on the target drive, it will be overwritten with the new configuration.

- Select **NO** to cancel the backup of the configuration. You will return to the Backup/Restore Conf menu.

Restore Configuration

1. Select the **Restore Configuration** option from the Backup/Restore Conf menu to restore a configuration to the array from a configuration file on a diskette. You'll be prompted to specify the name and location of the file containing the new configuration (Figure 4-24). The filename can be up to 10 characters, including the drive prefix. Avoid using full path-names. Enter the name of the file and press the Enter key.

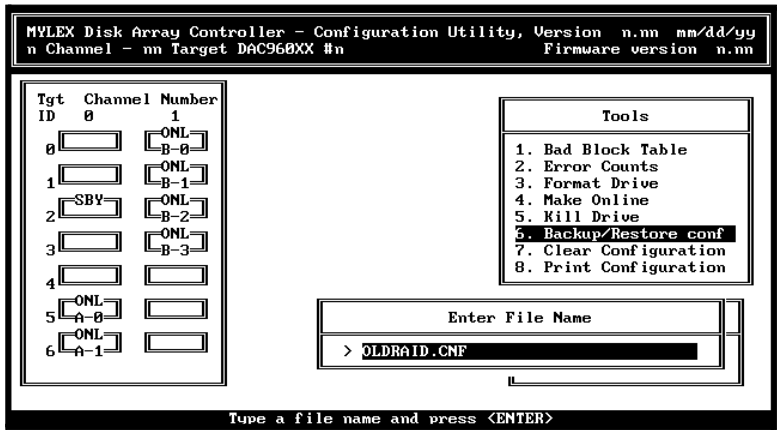


Figure 4-24. Specify the Filename Containing the Configuration

2. A confirmation box (Figure 4-25) will appear.

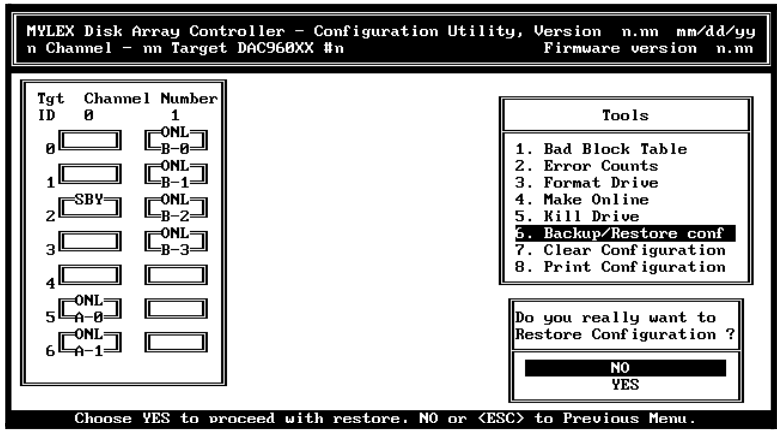


Figure 4-25. Restore Confirmation Box

- Select **YES** to restore the configuration. The configuration will be copied from the diskette to the array's non-volatile memory.

WARNING

Restoration of an array configuration will completely overwrite the contents of the current configuration. Therefore, any data residing on the array when the new configuration is implemented will be at risk. Use this option with caution, and then only after the current configuration has been saved to disk as well. The new configuration will be in effect when the controller is reset or the array is next power cycled.

- Select **NO** to cancel the restoration of the configuration. You will return to the Backup/Restore Conf menu.

Note: You can only restore configurations with files that were created by the Backup Configuration option. If a configuration file is created by other means and then used in a restoration, unpredictable array behavior will result.

Clear Configuration

Use the **Clear Configuration** option to erase an existing DAC960 configuration from memory. All drive groups, system drives, and RAID levels will be cleared. Any controller settings (hardware parameters) will remain unchanged.

WARNING

Any data on system drives will be lost when the configuration is cleared and a new configuration is created. Use this option with *extreme* caution, and ensure that you have made a backup of the configuration *before* clearing the configuration.

To clear a configuration, follow these steps:

1. Select **Clear Configuration** from the Tools menu. The Clear Configuration confirmation (Figure 4-26) will be displayed.

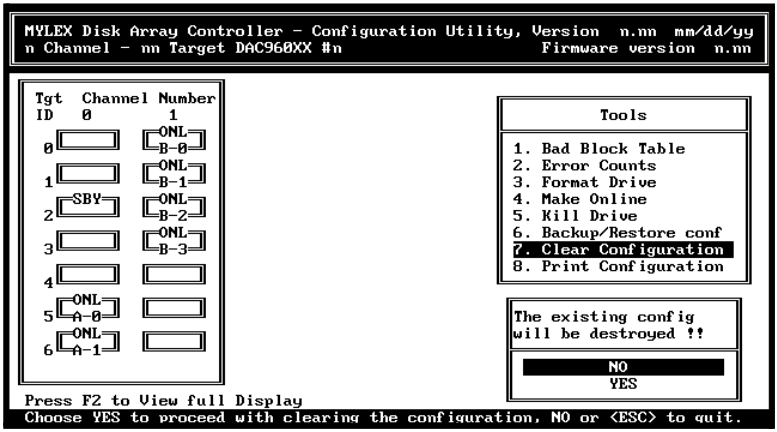


Figure 4-26. Clear Configuration Confirmation

- Select **YES** to clear the current configuration. You will return to the Tools menu.
- Select **NO** to abort the clearing of the configuration. You will also return to the Tools menu.

Note: All DAC960s are shipped with the configuration cleared.

Print Configuration

To create a printed copy of the configuration, which can be used to configure the array manually, follow these steps:

1. Select **Print Configuration** from the Tools menu. The output file name box will appear (Figure 4-27).

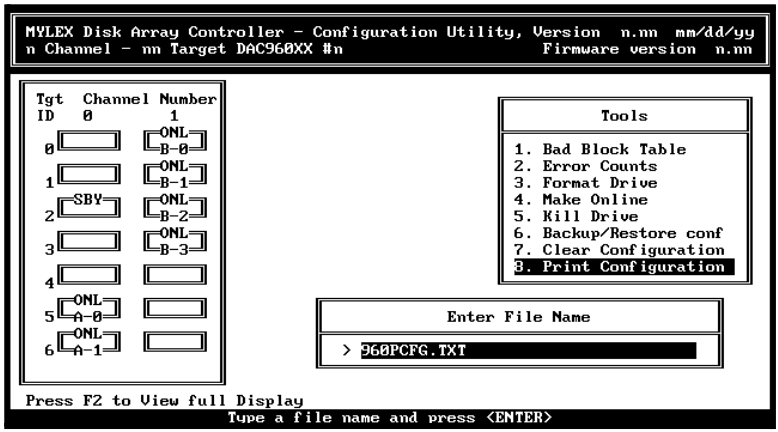


Figure 4-27. Specify the Configuration Text File

2. Input the name of the file and press the Enter key. The filename can be up to 10 characters, including the drive prefix. Avoid using full pathnames. Mylex suggests that you name the file so that you can easily recognize it when you need it; for example, RAID.TXT or ARRAY.TXT.

3. A confirmation box will appear.

   - Select **YES** to create the configuration text file. The system will pause briefly while the configuration file is written. A message at the bottom of the screen will display, indicating successful creation of the file. The resulting file will be written in ASCII text format, which can be viewed or printed with a word processor or text editor. To return to the Tools menu, press any key.
   - Select **NO** to abort the creation of the configuration description file. You will return to the Tools menu.

Mylex recommends that a printed copy of the output, along with a diskette containing both the file that created the printed copy and a copy of the configuration file created with the Backup Configuration utility be kept in a safe place.

While the output report is largely self-explanatory, a few items are worth noting:

In the section of the configuration report entitled *Physical Pack Information*, a line reading:

```
Pack 0 : [1:0]  [1:1]  [1:2]
```

- Indicates that three physical drives are part of the first drive group in the array.
- These physical drives are all located on controller channel #1, and have SCSI ID's of 0, 1, and 2, respectively.
- Furthermore, the drives were added to this drive group in the order in which they are listed, from left to right. In the example above, the drive with SCSI ID 0 was added first, followed by the drive set to SCSI ID 1, followed by the drive with SCSI ID 2.

In the section of the configuration report entitled *System Drive Information*, the column "Phy. Size" refers to the amount of space on the physical drive group which is occupied by a particular system drive. The column "Eff. Size" refers to the capacity of the system drive *as presented to the operating system with RAID levels taken into account*. In most cases, the numbers will be different, with the "Eff. Size" being the lesser of the two values.

Advanced Functions

To facilitate tuning of the array for optimal performance, a number of controller settings (as opposed to the array configuration stored in the controller's memory) can be changed. These controller settings, or parameters, are accessed by selecting the **Advanced Functions** option on the Main menu (Figure 4-28).

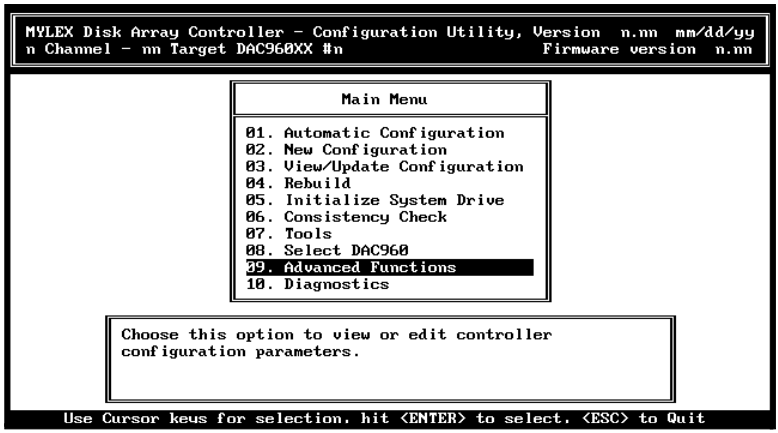

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to view or edit controller configuration parameters.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 4-28. Advanced Functions Option

When selected, the Edit/View Parameters menu appears (Figure 4-29).

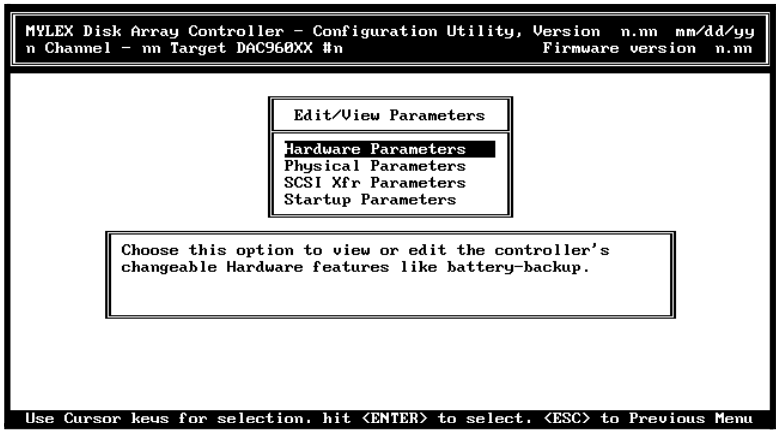

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Edit/View Parameters
Hardware Parameters
Physical Parameters
SCSI Xfr Parameters
Startup Parameters
Choose this option to view or edit the controller's changeable Hardware features like battery-backup.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-29. Edit/View Parameters Menu

Note: Different Mylex adapters support different Advanced functions. Not every function listed below may be available to your controller.

Any changes to controller parameters from the Advanced Functions menu or one of its sub-menus can be saved when exiting the Advanced Functions menu.

To exit the Advanced Functions menu, do the following:

1. Press the Esc key. A confirmation box will appear (Figure 4-30).

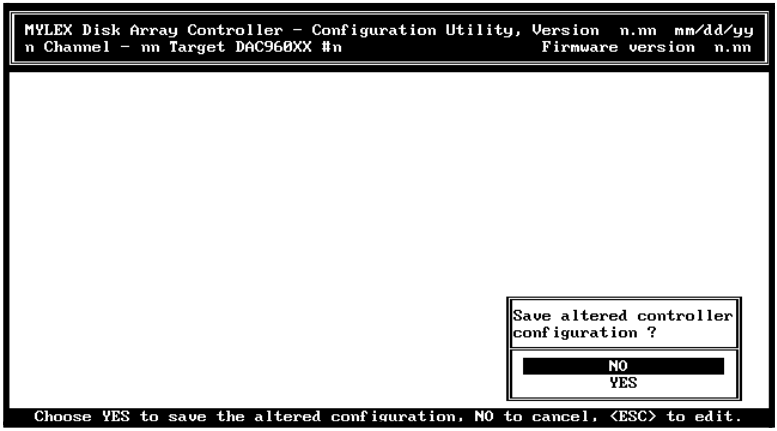

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Save altered controller configuration ?
NO
YES
Choose YES to save the altered configuration, NO to cancel, <ESC> to edit.

Figure 4-30. Save Controller Parameters Confirmation

- Select **YES** to save the new parameter settings. The parameters will be saved and you will return to the Main menu.
- Select **NO** to retain the parameter settings in effect before the Advanced Functions menu was entered. Any changes made will not be applied, and you will return to the Main menu.
- Press the Esc key to return to the Advanced Functions menu.

WARNING

Many of the advanced functions can put any data stored on the array at risk, if not delete it altogether. Such functions are noted in the manual, but Mylex recommends that you perform the modifications afforded by the advanced functions on an array that has *not* been loaded with a file system and data. Additionally, inappropriate changes to the controller parameter settings can result in degraded performance.

Hardware Parameters

Hardware parameters control specific DAC960 functions. To change any of the hardware parameters below, select **Hardware Parameters** from the Edit/View Parameters menu (Figure 4-31).

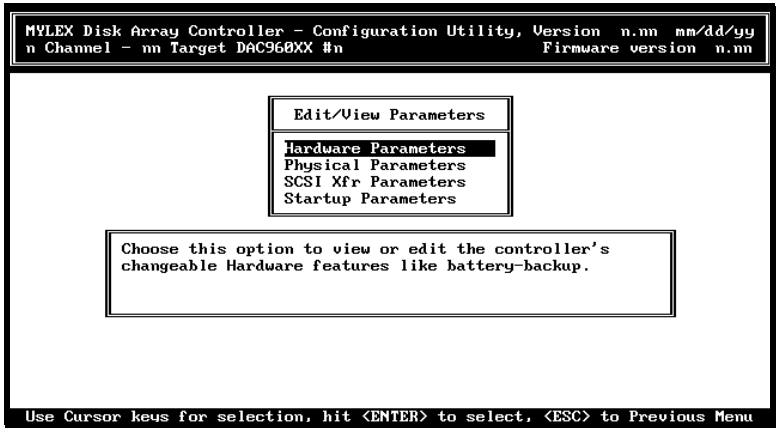

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Edit/View Parameters
Hardware Parameters
Physical Parameters
SCSI Xfr Parameters
Startup Parameters
Choose this option to view or edit the controller's changeable Hardware features like battery-backup.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-31. Hardware Parameters Option

The Hardware Parameters menu appears (Figure 4-32).

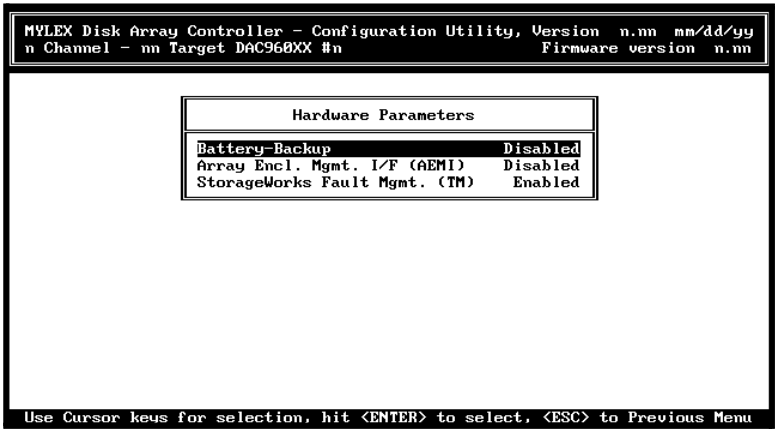

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Hardware Parameters
Battery-Backup Disabled
Array Encl. Mgmt. I/F (AEMI) Disabled
StorageWorks Fault Mgmt. (TM) Enabled
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-32. Hardware Parameters Menu

To change a hardware parameter, do the following:

1. Highlight the desired parameter using the cursor keys.
2. Press the Enter key to change the value.
3. When the correct value is displayed, either:
   - Repeat steps 1 & 2 above, but for a different parameter, or
   - Press the ESC key to return to the Edit/View Parameters menu. The change will be retained.

Battery Backup

Enable the battery backup option if you have installed a Mylex DBBU960-type battery backup module on your DAC960 Series controller. When installed and enabled, the battery backup unit will provide the required power should a power loss occur, protecting data on your arrays. See the "DBBU960 Battery Backup Module User's Manual" (Manual No. 771931) for further details on this function.

Automatic Rebuild Management

The Array Encl. Mgmt. I/F (AEMI) option refers to the Automatic Rebuild Management function, which works in conjunction with features in AEMI (Array Enclosure Management Interface) certified disk array enclosures. It detects the removal of a failed drive and performs an automatic rebuild after a replacement drive is installed into a redundant (fault tolerant) logical array (RAID 1, RAID 5, and RAID 1+0).

Automatic Rebuild Management requires hardware compatibility with disk array enclosures that are certified AEMI compliant.

Operational Fault Management

The StorageWorks Fault Mgmt. (TM) option monitors and reports drive failures, background activity completion status, enclosure events, etc. This function should remain enabled during normal controller operation. Do not disable this function unless specifically instructed to do so as part of a trouble-shooting diagnostic activity.

Physical Parameters

Physical parameters define the interaction between the controller and the disk drives. To change any physical parameter select **Physical Parameters** from the Edit/View Parameters menu (Figure 4-33).

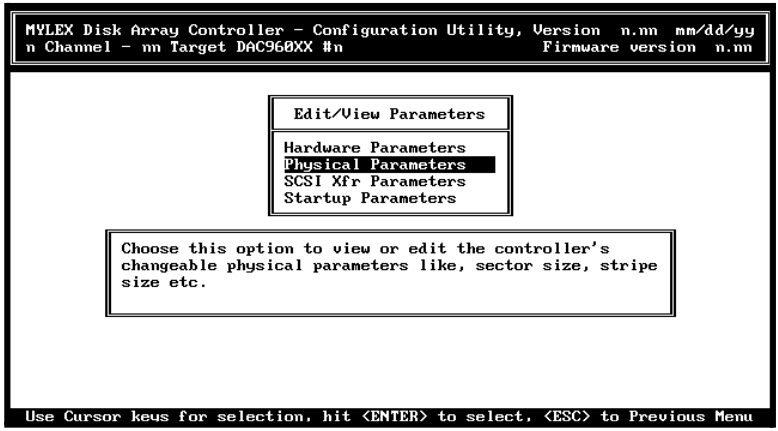

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Edit/View Parameters
Hardware Parameters
Physical Parameters
SCSI Xfr Parameters
Startup Parameters
Choose this option to view or edit the controller's changeable physical parameters like, sector size, stripe size etc.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-33. Physical Parameters Option

The Physical Parameters menu appears (Figure 4-34).

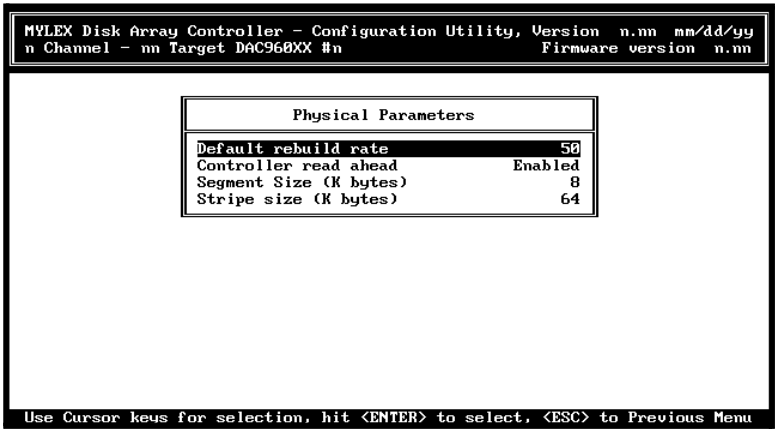

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Physical Parameters
Default rebuild rate 50
Controller read ahead Enabled
Segment Size (K bytes) 8
Stripe size (K bytes) 64
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-34. Physical Parameters Menu

To change a physical parameter, do the following:

1. Highlight the desired parameter using the cursor keys.
2. Press the Enter key to change the value.
3. When the correct value is displayed, either:
   - Repeat steps 1 & 2 above, but for a different parameter, or
   - Press the Esc key to return to the Edit/View Parameters menu. The change will be retained.

Default Rebuild Rate

The rebuild rate is a relative indication of how much time the controller devotes to a rebuild operation. Integer values from 0-50 can be defined. For low rebuild priority and high array performance, specify a value of 0. For high rebuild performance (and reduced array performance during rebuild), select 50.

Controller Read Ahead

The Controller Read Ahead function improves data retrieval performance by allowing the controller to read into cache a full stripe of data at a time. This greatly improves the percentage of cache hits.

For example, if the stripe size is set to 8k and the host requests 1k of data, when this function is enabled the controller will read ahead the full 8k. When the host requests the next 1k block, that data will already be in the controller's cache.

Note: Users of DAC960 firmware version 2.6 and above may disable this option. The controller adaptively reads ahead in any case. Firmware below version 2.6 does not possess adaptive read-ahead caching, so this function should remain enabled during normal controller operation.

Super Read Ahead (DAC960S Only!)

The Super Read Ahead function for DAC960S controllers increases performance for applications that must access large blocks of sequential data. This function incorporates intelligent data request monitoring to track data requests by the host. With Super Read Ahead enabled, the controller detects requests for data that are stored in sequence on the drives. It reads the data into the cache so that the cache remains at least one request ahead of the host. This function, if available, should remain enabled during normal controller operation.

Segment Size

The Segment Size function, available in DAC960 firmware version 2.6 and above, is set in conjunction with stripe size and represents the size of the data "chunk" that will be read or written at one time. Under DACCF, the segment size (also known as "cache line size") should be based on the stripe size you selected. (See Table 3-1 in Chapter 3 for the available segment size settings to use for each stripe size.) The default segment size for Mylex DAC960 controllers is 8K.

A large segment size (64K) is useful when accompanying a 64K stripe size for applications requiring large sequential reads or writes (such as video playback from disk). However, it can actually hinder system performance if files are smaller or if data access is more random than sequential. Small segment sizes (especially 8K) are best for most data processing situations.

Stripe Size

The Stripe size function is used to tune the controller performance for a specific environment or application. Generally, stripe size optimization is as follows:

- Smaller stripe sizes provide better performance for random I/O (e.g., RAID 5, network file service, or OLTP processing)
- Larger stripe sizes provide better performance for sequential transfers (e.g., RAID 0, RAID 1+0; digital video, etc.).

Available stripe sizes are 8K, 16K, 32K, and 64K. For firmware versions below 2.6, the default stripe size for Mylex DAC960 Series controllers is 8K. For firmware versions at or above 2.6, the default stripe size is 64K.

WARNING

DATA LOSS will occur after changing the stripe size on a controller with *existing* logical arrays. *Always* back-up all of the drives before making a stripe size change, and *always* reconfigure and initialize the logical array after a new stripe size is saved.

Logical Sector Size (DAC960S Only!)

The logical sector size (shown only for DAC960S controllers), is fixed at 512 bytes and cannot be altered. The menu option only allows you to view the parameter.

Physical Sector Size (DAC960S Only!)

The physical sector size of a disk drive (shown only for DAC960S controllers), is dependent upon the disk drive, and also cannot be altered. The menu option only allows you to view the parameter.

SCSI Transfer Parameters

SCSI transfer parameters control the interaction between SCSI devices and the host adapter. To change any SCSI transfer parameter below, select **SCSI Xfr Parameters** from the Edit/View Parameters menu (Figure 4-35).

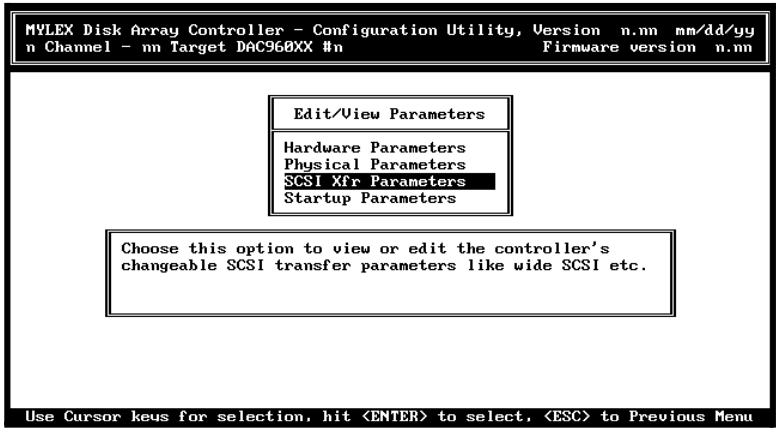

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Edit/View Parameters
Hardware Parameters
Physical Parameters
SCSI Xfr Parameters
Startup Parameters
Choose this option to view or edit the controller's changeable SCSI transfer parameters like wide SCSI etc.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-35. SCSI Transfer Parameters Option

A dialog box appears requesting that you select the channel whose SCSI transfer parameters you would like to change (Figure 4-36).

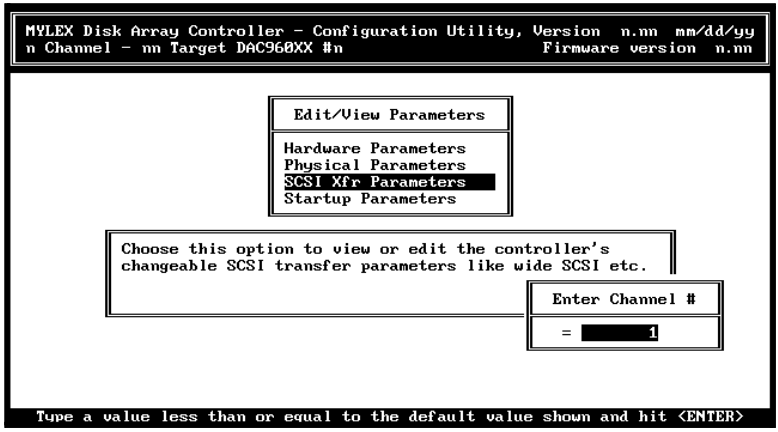

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Edit/View Parameters
Hardware Parameters
Physical Parameters
SCSI Xfr Parameters
Startup Parameters
Choose this option to view or edit the controller's changeable SCSI transfer parameters like wide SCSI etc.
Enter Channel #
= 1
Type a value less than or equal to the default value shown and hit <ENTER>

Figure 4-36. Enter the Channel Number

- Type the channel number and press Enter, or simply press Enter to accept the default.

The SCSI Transfer Parameters menu appears, specifying the appropriate

channel (Figure 4-37).

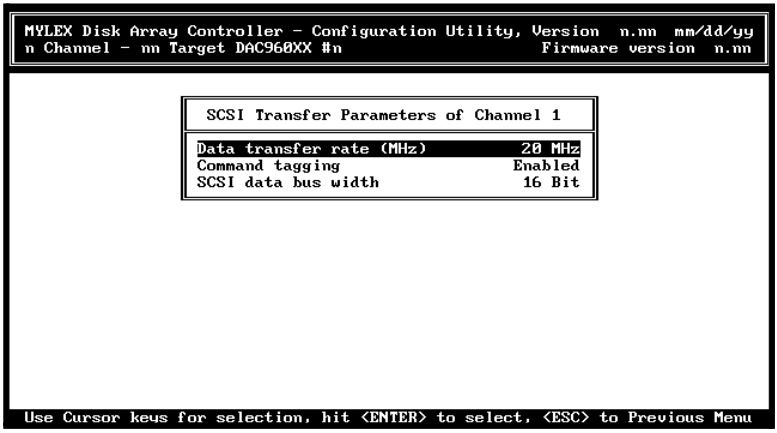

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
SCSI Transfer Parameters of Channel 1
Data transfer rate (MHz) 20 MHz
Command tagging Enabled
SCSI data bus width 16 Bit
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-37. SCSI Transfer Parameters Menu

To change a SCSI transfer parameter, do the following:

1. Highlight the desired parameter using the cursor keys.
2. Press the Enter key to change the value.
3. When the correct value is displayed, either:
   - Repeat steps 1 & 2 above, but for a different parameter, or
   - Press the ESC key to return to the Edit/View Parameters menu. The change will be retained.

Data Transfer Rate, MHz

The SCSI Transfer function sets the maximum transfer rate for each drive channel. The default setting is 20MHz. This setting produces 10 MB/sec transfers for Fast SCSI and 40 MB/sec transfers for Wide and Ultra SCSI. The default setting should be changed only if problems are encountered in communicating with a drive. Do not change the default setting unless you are doing so as part of a troubleshooting activity.

Note: Problems communicating with a drive can be caused by several conditions; e.g., improper termination, wrong drive ID setting, SCSI cable is too long, faulty equipment, etc.

Command Tagging

Command tagging controls SCSI command tag queuing support for each drive channel. This function normally remains enabled. Disable only when using older SCSI drives not supporting command tag queuing.

SCSI Data Bus Width

The Force 8bit (Drive Channel) function allows the controller to communicate with Wide SCSI (16 bit) devices connected to it through a Narrow SCSI (8 bit) data cable on the specified drive channel.

Startup Parameters

Device startup parameters affect the power consumption of the disk devices within the array. A running drive consumes a fraction of the power necessary to start the drive. To minimize the strain on the power supply of the array, the drives can be started in sequence, spreading the consumption of power out over a defined period of time. To change any device startup parameter below, select **Startup Parameters** from the Edit/View Parameters menu (Figure 4-38).

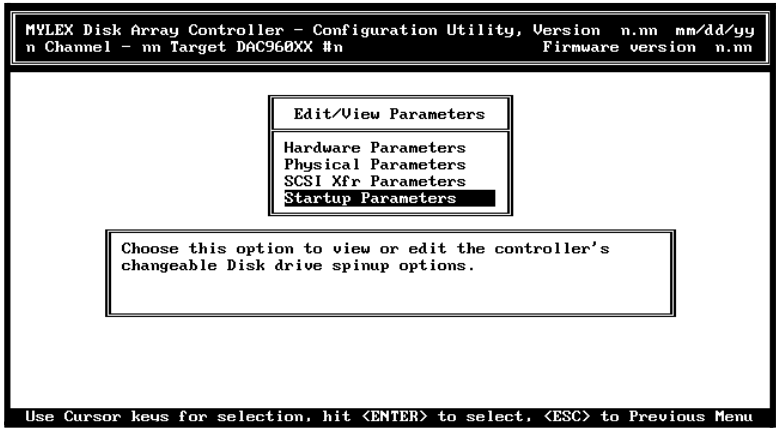

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n
Firmware version n.nn
Edit/View Parameters
Hardware Parameters
Physical Parameters
SCSI Xfr Parameters
Startup Parameters
Choose this option to view or edit the controller's changeable Disk drive spinup options.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-38. Startup Parameters Option

The Start up Parameters menu appears (Figure 4-39).

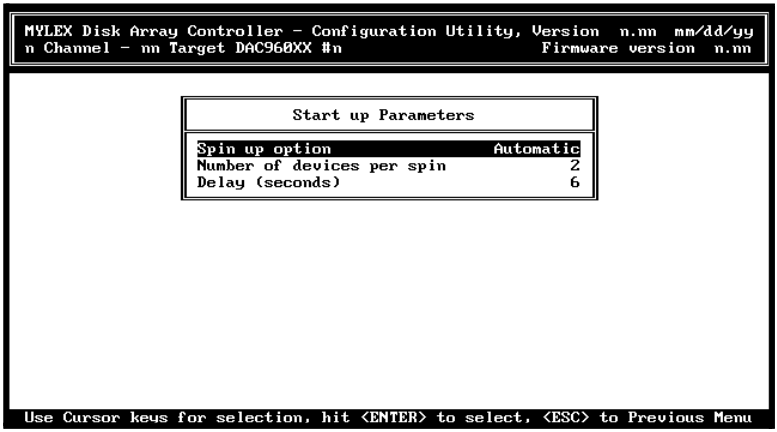

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Start up Parameters
Spin up option Automatic
Number of devices per spin 2
Delay (seconds) 6
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Previous Menu

Figure 4-39. Start Up Parameters Menu

To change a parameter, do the following:

1. Highlight the desired parameter using the cursor keys.
2. Press the Enter key to change the value.
3. When the correct value is displayed, either:
   - Repeat steps 1 & 2 above, but for a different parameter, or
   - Press the Esc key to return to the Advanced Functions menu. The change will be retained.

Spin Up Option

The Spin-up function controls how the SCSI drives in the array are started (spun-up). There are three different Spin-up modes that may be selected by the user. The default mode setting is Automatic.

Automatic This spin-up mode causes the controller to spin-up all connected drives, two-at-a-time at six second intervals, until every drive in the array is spinning. The controller then interrogates each drive, one-at-a-time at six second intervals, and confirms that the drive is ready for use. The interrogation process repeats until all drives have been verified.

On Power This spin-up mode assumes that all drives are already spinning and proceeds to interrogate the drives in the same manner as described for Automatic mode.

On Command This spin-up mode causes the controller to wait for a spin-up command from the host. It then proceeds to spin-up the drives in the same manner as described for Automatic mode.

Number of Devices Per Spin

Specify the number of drives to spin up. Values range from 1 to 6.

Delay

After the controller completes its initialization process, the delay value defines the number of seconds before the first disk interrogation request is issued to the array. Delay values range from 0 to 30 in six second increments.

Device Management

From time to time, you may have to manage individual physical devices in your array. This includes removing and replacing disk drives and ensuring that the controller keeps track of these operations. For example, a drive that has failed may need to be replaced. An extra, existing standby drive may be required elsewhere and therefore, need to be removed from the array. A new drive may need to be added to the array as a standby, or hot spare drive to provide automatic fault-tolerance. This section describes how to accomplish these and other tasks.

Tools

Many of the functions necessary to ensure continued data availability before, during, and after a drive is replaced are found in the Tools menu. Activate the Tools menu (Figure 4-40) by selecting **Tools** from the Main menu.

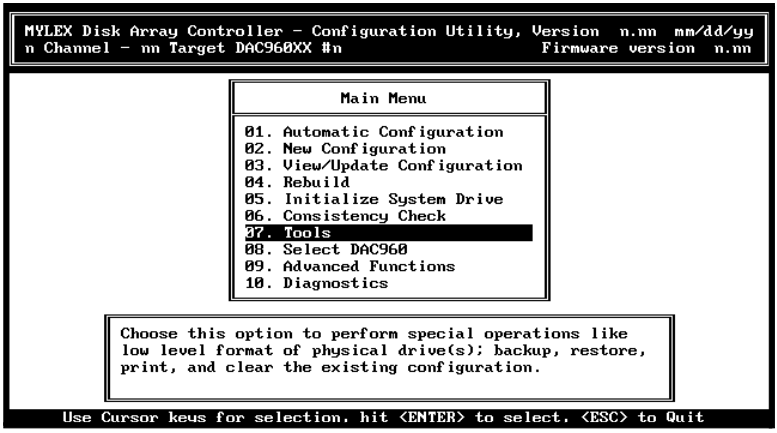

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Main Menu
01. Automatic Configuration
02. New Configuration
03. View/Update Configuration
04. Rebuild
05. Initialize System Drive
06. Consistency Check
07. Tools
08. Select DAC960
09. Advanced Functions
10. Diagnostics
Choose this option to perform special operations like low level format of physical drive(s); backup, restore, print, and clear the existing configuration.
Use Cursor keys for selection, hit <ENTER> to select, <ESC> to Quit

Figure 4-40. Tools Option

Bad Block Table (Bad Data Table)

A bad block is defined as a section on a physical disk which cannot reliably store information. Viewing the table to inspect the number and location of bad blocks can be used to troubleshoot a failed rebuild operation, or can help predict a physical drive failure. The Bad Block Table option lets you view the two tables that the DAC960 maintains during both a rebuild process as well as normal operation.

To view either (or both) of these tables, select **Bad Block Table** from the Tools menu. The View Bad Block Table menu appears (Figure 4-41).

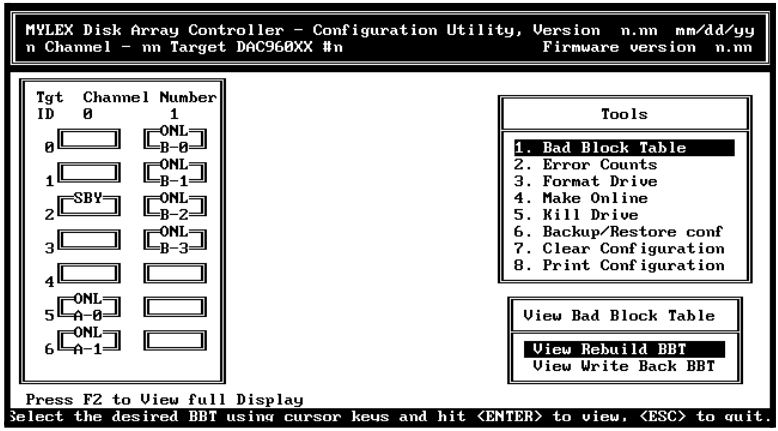


Figure 4-41. View Bad Block Table Menu

Note: A bad block table is cleared after viewing. Make sure that you record any information either by saving the table to another disk drive or by manually transcribing the information in the table.

View Rebuild BBT. During a rebuild operation, data is read from existing redundant drives in the drive group, reconstructed by the controller, and then written to the replacement drive. If a read error (on an existing drive) occurs during a rebuild, the process will fail. In that case, one of the existing drives (not the replacement drive) has errors. Select the **View Rebuild BBT** option to determine which drive has errors.

View Write Back BBT. During normal operation if you have a system drive's write policy set to *write back*, a second bad block table is maintained in the controller's memory. This table is updated whenever an error occurs during a read or write operation.

Error Counts for a Device

The Mylex DAC960 Series controllers maintain several tables of disk errors that are encountered during normal operation. These tables are called error count tables. To view the error counts for a device, do the following:

1. Select **Error Counts** from the Tools menu.
2. The highlighted cursor will be positioned at the first device on the channel of the lowest numeric value.
3. Using cursor keys or a pointing device, select any disk device that is displayed.
4. The Error Counts Table for that device will be displayed (Figure 4-42).

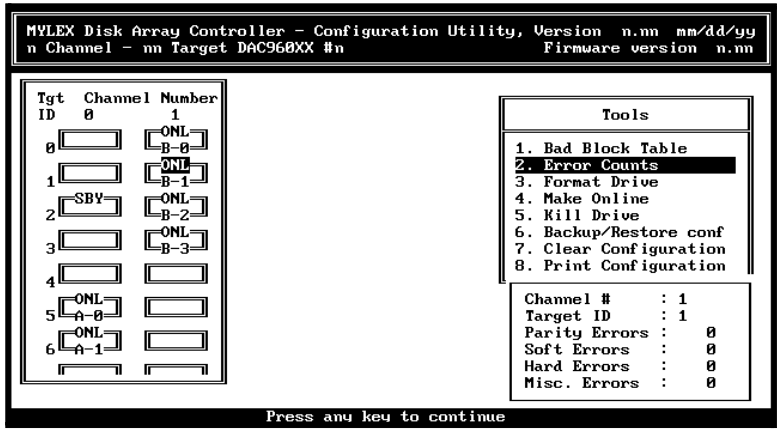


Figure 4-42. Error Counts for a Device

Error Count Tables can be used to monitor the "health" of a device and to indicate when a device needs to be repaired or replaced. Viewing the error counts for a particular device displays the number of errors in each table for the selected device.

Error counters have the following properties:

- A maximum of 127 errors can be recorded for each device in each table.
- Error counters can be reset to 0 by power-cycling the array controller.

Parity errors. A count of the SCSI bus parity errors that occurred while this device was transferring information on the bus.

Soft errors. A count of “check-condition” errors reported by the device. These errors are typically generated when a bad sector on the disk is encountered. Such errors are recovered by the DAC960 (if the device is part of a redundant system drive) by generating the data from the remaining disks. The bad sector on the device is also eliminated by writing back the data onto the disk and reading to verify, since a verify failure results in the re-assignment of data to a different sector. Soft errors may occur during normal operation if the device has bad sectors.

Hard errors. Hardware-related errors on the DAC960 controller. The following conditions cause the hardware error count to be incremented for a device:

- SIOP interrupt for ‘Illegal instruction detected’.
- SIOP interrupt for ‘Gross error’
- SCSI device executed illegal/unsupported phase sequence.

During normal operation, the hard error count for any device should be zero.

Miscellaneous errors. All other errors:

- A device times out on a command issued to it by the DAC960. The current time-out limit for a read/write command to a disk is six seconds.
- An active device was busy when the controller attempted to send it a command.

Appendix A
DACCF File List

DAC960 Series controllers are shipped with a number of software support files on a distribution diskette that is formatted for use with MS-DOS. The tables below display the structure and content of the distribution disk for the DAC960 product families.

Host-Based DAC960 Products

Directory	Filename
\DACCFG	DACCF.EXE
\DOS	ADPIDAC.SYS DACDRVR.SYS DAFCDA.EXE
\UTILS	DAC960FL.EXE

SCSI-TO-SCSI DAC960 Products

Directory	Filename
\DACCFG	DACCF.EXE READCFG.ME
\FIRMWARE	FW.EXE
\TOOLS	SLP1TK.EXE TERM7.EXE
\	DISKLIST.EXE READDAC.ME

Appendix B
Frequently-Asked Questions

How do I set up a standby drive using DACCF?

When initially creating the drive groups, do not include one or more drives in a drive group. The drive should have a status of 'RDY'. After drive groups have been arranged and the configuration saved, the excluded drives assume a status of 'SBY', or Standby. There's another way to create standby drives, and that's detailed below.

What is the procedure to set up a RAID (0,1,5,6,7) system?

See the Overview in "Chapter 3: Preparing the Array" for a quick summary of the steps. A RAID system will require several disks for redundancy.

How many drives are needed to setup a RAID (0,1,5,6,7) system?

Minimum Number of Drives	**RAID Levels Available**
1	Mylex RAID 7, also known as JBOD
2	0, 1
3 or more	0, 5, 0+1 (also known as Mylex RAID 6)

I get a message, "adapter not responding to command." What does this mean, and what should I do?

This error indicates a time-out condition with a SCSI device--either the controller or one of the devices on the SCSI chain. To determine the location of the problem, remove all cabling from the controller, and try to run DACCF again. If the error persists, the controller needs servicing. If the error does not reappear, then check your devices and cabling.

The message, "Error writing configuration" has appeared. What should I do?

This message is most commonly displayed when there is no +12V power source to the main logic board of the computer system. Newer systems have 3.3V connectors as well, and occasionally the +12V line is not attached to the board. Check your internal power connectors first. There may also be a problem with the Non-volatile RAM (NVRAM) or the EEPROM on the controller. The configuration is written to both of these memories. If you're sure that you have +12V power, try changing the EEPROM or the NVRAM.

I get an error message saying, "Initialization failed." What should I do?

This condition occurs when a drive is not responding to controller commands during the initialization process. Verify the operation of the individual devices using the Tools menu, and if necessary, replace the malfunctioning drive(s).

I have a hot spare configuration. One of my disks failed and the hot spare took over. I've replaced the failed disk, but cannot get the controller to recognize the replacement disk, which can now become the hot spare. What should I do?

Follow these steps:

1. Disconnect the replacement drive.
2. Invoke DACCF.
3. Select **View/Update Configuration** from the Main menu.
4. Select **Define System Drive** from the View/Update Configuration menu.
5. Select **Toggle Write Policy** from the System Drive Definition menu.
6. Press the Enter key to change the write policy for the first (or any) system drive, then highlight the same drive, and press the Enter key to change it back to its original value.
7. Press the ESC key twice.
8. Answer **YES** to save the updated configuration (although, in effect, nothing has been changed.)

9. Exit DACCF.
10. Connect the replacement drive.
11. Invoke DACCF.
12. Select **View/Update Configuration** from the Main menu.
13. Press the ESC key.
14. Answer **YES** to save the new configuration and the unconfigured drive(s) as standby drives.
15. Verify that the drive is a standby drive by selecting **View/Update Configuration** again from the Main menu. The replacement drive should have a status of 'SBY'.

I've replaced a drive that the controller made "dead." Now what do I do to recover the data?

The following procedure will **only** work for "replaced" drives that are part of a **RAID 1, 5, or 6** drive group. Using the Main menu, do the following:

1. Select **Rebuild**.
2. Highlight the drive that has been replaced. The status should read 'DED'. Press the Enter key.
3. DACCF will ask you if you want to low-level format the drive.
   - If this is a new drive that has not been used in this array before, allow the drive to be low-level formatted before the rebuild takes place by answering **YES**.
   - Answering **NO** will skip the low-level format and proceed directly to the rebuild of data on the "new" drive.
4. Any defined system drives will then be rebuilt on the "new" drive in sequential order.

How do I change the write policy on a existing configuration?

To change the write policy, follow these steps:

1. Select **View/Update Configuration** from the Main menu.
2. Select **Define System Drives** from the View/Update Configuration menu.

3. Select **Toggle Write Policy** from the System Drive Definition menu.
4. Highlight the desired system drive using a mouse or the cursor keys, and press the Enter key to change the write policy for that drive.
5. Repeat step (4) for other system drives.
6. When finished, press the ESC key twice and answer **YES** when prompted to save the configuration.

Do I need to initialize the system drive again after changing the controller cache write policy?

No! Initialization of the system drive will *erase* any data that is stored on it.

When I make a new drive on-line, all my data is corrupted. When should I use the "Make On-line" option?

The "Make On-line" option should only be used in an emergency situation when data has to be recovered from a disk array. It can be used if a fault-tolerant array is running in a critical state (that is, a drive has failed and the array is reading and writing using mirror or parity information) and another drive failure occurs. At this point, the array has lost the ability to store data. The Make On-line option forces the drive on-line so that the information can be copied to another medium.

Use the Rebuild function to reconstruct data on a new drive that has just replaced a failed drive.

Why do I need to copy DACCF to a boot disk? I don't even have a second floppy drive!

Putting DACCF on a bootable floppy disk is suggested merely as a convenience. It's not an absolute requirement. Having a boot disk with DACCF just makes life easier when installing the array for the first time, or in the event that a situation occurs where the array cannot be accessed otherwise.

Are there command line switches or arguments for DACCF?

See Appendix C.

Appendix C

Command Line Arguments

DACCF can be started with additional command line arguments, or parameters. These parameters and their functions are presented below.

Multiple arguments can be supplied, if separated by a space. The syntax for supplying the arguments is as follows:

DACCF [-argument1 -argument2 -argument3]

WARNING

Some command line arguments can potentially cause data loss if used improperly. Use caution when running the DACCF program with one or more arguments.

Parameter	Function
-s	This is used to configure the DAC960S when you are using serial port COM1 to configure the array. A null-modem cable must connect the COM1 port of the computer to the serial interface on the DAC960S. All communication with the controller is then accomplished via the serial link.
-ddfc	This sets a bit to disable a disconnect on first command by any device on the SCSI bus. This switch is available to fix a problem seen in some devices that try to negotiate on a reconnect, a function which is not supported by the DAC960. Seagate Hawk drives with some firmware levels, some Seagate Barracuda drives and some older IBM drives are known to attempt to do this. If a drive is not seen on power-up but can be accessed after a warm boot, this could be the problem. If you see a drive go off line for no apparent reason, this could also be the problem. To remedy this situation, run “DACCF -DDFC”. Once the main menu is displayed, you can then exit the utility. The bit will be set.
-edfc	This resets the bit to allow disconnects on first command.

Appendix D

DACCF Error Conditions

NVRAM/Flash Configuration Mismatch

The DAC960 stores two copies of the array configuration in different memories of the controller. One copy is stored in Non-volatile RAM, the other in an Electrically Eraseable Read Only Memory, or Flash EEPROM. During initialization, DACCF compares each copy of the configuration. If a difference is detected, the error message above is displayed. To remedy this problem:

1. Press any key. The Load Configuration screen will display.
2. Select the source to view, either NVRAM or FLASH memory. In most cases, the information stored in FLASH memory will be more accurate, and Mylex recommends that you check that source first.
3. Review the configuration from the selected source, and decide if this source should be saved to both sources.
   - To save the configuration, Press the “S” key.
   - To not save the configuration, and to review the other source for a more accurate copy of the configuration, follow the directions on the screen.

Installation Abort

The Installation Abort message () appears when the configuration information stored in the controller’s memory doesn’t agree with the state of the drives as reported by the DAC960 BIOS during power-up.

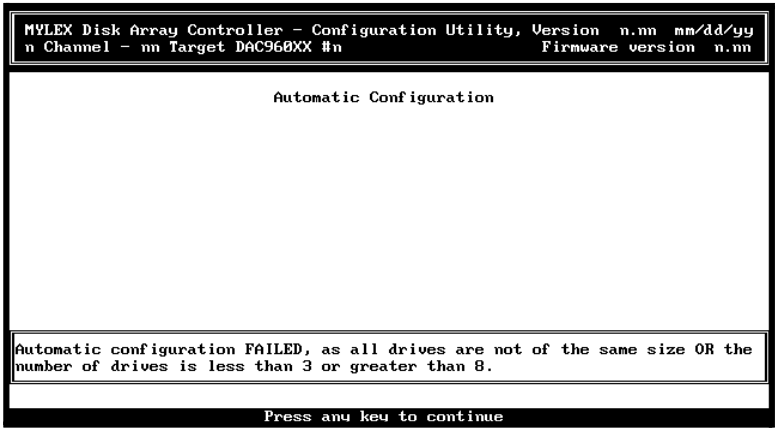

MYLEX Disk Array Controller - Configuration Utility, Version n.nn mm/dd/yy
n Channel - nn Target DAC960XX #n Firmware version n.nn
Automatic Configuration
Automatic configuration FAILED, as all drives are not of the same size OR the number of drives is less than 3 or greater than 8.
Press any key to continue

Figure D-1. Installation Abort Message

To fix this condition:

1. Ensure that all devices are connected, powered on, and functioning properly.
2. Reboot the computer system.

If the problem persists, do the following:

1. Rerun DACCF.
2. When the error message is displayed, press any key. A summary of the state of the devices will be displayed.
   - To save the setup, press the S key. The configuration will be saved and you'll be returned to the Main menu.
   - To abort the automatic configuration process, press the ESC key. At this point, you will need to turn off power to the array and to the computer and either resolve the hardware problem (by adding or removing disk drives as necessary) or decide to perform a manual configuration. The computer and array must then be powered on, and DACCF rerun.
3. Power cycle the array and the computer.
4. Rerun DACCF.

Configuration Checksum Error

If the DAC960's firmware is updated, this error message may appear the first time DACCF is run *after* the update process. To eliminate the condition:

1. Save the default configuration.
2. Power-cycle the array.
3. Reboot the computer.
4. Rerun DACCF.
5. Restore the configuration from a diskette containing a copy of the previously-saved configuration.

Errors Which Cause a Drive to be Killed

There are multiple conditions which will cause the DAC960 to "kill" or deactivate a drive from read/write operations. They are as follows:

SCSI Sequence Error

Whenever a device follows an illegal SCSI phase sequence (i.e., an unexpected disconnect,) the controller resets the SCSI bus and then interrogates all of the drives it expects to be there. If all the drives respond properly, operation continues. If any drive fails to respond, the controller kills that drive.

SCSI Busy Status

When a drive gives the controller a BUSY response, the controller retries the command. If the count of BUSY responses from a drive exceeds a pre-set value (currently set at 48), the drive is killed.

Timeout on a Command

If a drive does not complete a command issued to it within a pre-set timeout period (currently set at six seconds), the DAC960 resets the SCSI bus, interrogates the drive, and kills it if the interrogation fails. The timeout condition also applies to drives that "hold" the SCSI bus for a long period.

Media Error Recovery Flow

If a drive reports a media error on a read command, the DAC960 reconstructs the data from the mirror, or from parity and data on other drives. It then writes the data to a different area of the disk to “clean” the error if possible. The data is read from the new location for verification. If the read of the data at the new location fails, the DAC960 issues a reassign to the drive (selecting another new location) and then repeats the write/verify operation. A reassign failure or two successive failures in verification will result in the drive being killed.

Interrogation Sequence - Start Drive

During the drive startup sequence, the DAC960 issues several SCSI commands (Inquiry, TUR, Sync negotiation and, when supported, Wide negotiation.) Following these commands, the DAC960 issues a read command on a reserved block of the drive. The timeout for all of these commands is three seconds. If any error (including timeout) is encountered during the interrogation sequence, the drive is killed. The interrogation sequence is performed for each drive every time an error occurs on the bus which requires a SCSI Reset.

Operator Command

A drive can also be killed via DACCF, or via a Mylex utility for a specific operating system.

Glossary

Bad Block Table (or Bad Data Table)

There are two bad-block tables that the controller automatically maintains: The Rebuild Bad Block Table stores information on bad blocks encountered during a rebuild or consistency check process. The Write-Back Bad Block Table stores information on all irrecoverable write-back errors that occur. DACCF provides commands that allow you to see either of these two tables.

Cache

Controller memory used to speed up data transfer to and from a disk.

Cache Flush

Refers to an operation where all unwritten blocks in a Write-Back Cache are written to the target disk. This operation is necessary before powering down the system.

Cache Line Size

See “Segment Size” .

Channel

Refers to one SCSI bus on a DAC960 Series controller. Each DAC960 provides at least one channel, and additional channels with optional upgrades.

Consistency Check

Refers to a process where the integrity of redundant data is verified. For example, a consistency check of a mirrored drive will make sure that the data on both drives of the mirrored pair is exactly the same. For RAID Level 5 redundancy, a consistency “connect” is a function that allows a target SCSI device (typically a disk drive that received a request to perform a relatively long I/O operation) to release the SCSI bus so that the controller can send commands to other devices. When the operation is complete and the SCSI bus is needed by the disconnected target again, it is “reconnected.”

Disk Failure Detection

The controller automatically detects SCSI disk failures. A monitoring process running on the controller checks, among other things, elapsed time on all commands issued to disks. A time-out causes the disk to be “reset” and the command to be retried. If the command times out again, the disk could be “killed” (taken “offline”) by the controller (its state changed to “dead”). DAC960 Series controllers also monitor SCSI bus parity errors and other potential problems. Any disk with too many errors will also be ‘killed’.

Disk Media Error Management

DAC960 Series controllers transparently manage SCSI disk media errors. Disks are programmed to report errors, even ECC-recoverable errors.

When a disk reports a media error during a read, the controller reads the data from the mirror (RAID 1 or 0+1), or computes the data from the other blocks (RAID 5), and writes the data back to the disk that encountered the error. If the write fails (media error on write), the controller issues a “reassign” command to the disk, and then writes the data to a new location. Since the problem has been resolved, no error is reported to the system.

When a disk reports a media error during a write, the controller issues a “reassign” command to the disk, and writes the data out to a new location on the disk.

Drive Groups (or Drive Packs)

A group of individual disk drives (preferably identical) that are logically tied to each other and are addressed as a single unit. In some cases this may be called a drive “pack” when referring to just the physical devices. Up to eight (8) drives can be configured together as one drive group.

All the physical devices in a drive group should have the same size, otherwise each of the disks in the group will effectively have the capacity of the smallest member. The total size of the drive group will be the size of the smallest disk in the group multiplied by the number of disks in the group. For example, if you have 4 disks of 400MB each, and 1 disk of 200MB in a pack, the effective capacity available for use is only 1000MB (4*200), not 1800MB.

Hot Replacement of Disks ("Hot Swap")

The design of the DAC960 Series controllers allows for the replacement of failed hard disk drives without interruption of system service. In the event of a SCSI drive failure on a properly configured system (where the data redundancy features of the controller are used), system service continues without interruption. A message is generated by the system to alert the system operator.

When a replacement drive becomes available, the system operator can remove the failed disk drive, install a new disk drive, and instruct the controller to "rebuild" the data on the new drive, all without interrupting system operations.

Once the rebuild is complete, the controller will be brought back into a fault tolerant state.

Logical Drive States

The state of a logical (system) drive can be either ONLINE, CRITICAL, or OFFLINE. Notice that the same term "online" is used for both physical and logical drives.

Online: A Logical Drive is in an "online" state if...

All of its participating SCSI drives are "online."

Critical: A Logical Drive is in a "critical" state if...

It has been configured at RAID level 1, 5, or 0+1; and

One (and only one) of its SCSI drives is not "online."

A logical drive is considered "critical" because any failure of another of its SCSI drives may result in a loss of data.

> **Note:** I/O operation can only be performed with system drives that are online or critical.

Offline: A Logical Drive is in an "offline" state if...

No data can be read from it or written to it.

System commands issued to offline logical drives are returned with an error status: no operations can be performed on offline logical drives. A logical drive can be "offline" under one of two situations described below:

- It is configured with a redundant RAID level (1, 5, or 0+1), and two or more of its SCSI drives are not "online"; or
- It is configured at RAID level 0, JBOD, or in a spanned set, and one or more of its SCSI drives are not "online."

Logical Drives

See"System Drives" .

Mirroring

Refers to the 100% duplication of data on one disk drive to another disk drive. Each disk will be the mirror image of the other.

Pack

See "Drive Groups (or Drive Packs)" .

Parity

See "Rotated XOR Redundancy" .

RAID

RAID stands for Redundant Array of Independent Disks. The DAC960 Series controllers implement this technology to connect up to 7 SCSI devices simultaneously on each channel for firmware versions below 3.0, and up to 15 SCSI devices per channel for firmware 3.0 and above. Several different forms of RAID implementation have been defined. Each form is usually referred to as a "RAID level." All the RAID levels supported by DAC960 Series controllers are shown below.

The appropriate RAID level for a system is selected by the system manager or integrator. This decision will be based on which of the following are to be emphasized:

Disk Capacity

Data Availability (redundancy or fault tolerance)

Disk Performance

RAID Levels

Level 0. Block "striping" across multiple drives is provided, yielding higher performance than is possible with individual drives. This level does not provide any redundancy.

Level 1. Drives are paired and mirrored. All data is 100% duplicated on a drive of equivalent size.

Level 5. Data is "striped" across several physical drives. For data redundancy, drives are encoded with rotated XOR redundancy.

Level 0+1. Combines RAID 0 striping and RAID 1 mirroring. This level provides redundancy through mirroring. (Mylex RAID 6)

JBOD. Sometimes referred to as "Just a Bunch of Drives." Each drive is operated independently like a normal disk controller, or drives may be spanned and seen as a single drive. This level does not provide data redundancy. (Mylex RAID 7)

> **Note:** The host operating system drivers and software utilities remain unchanged regardless of the level of RAID installed. The controller makes the physical configuration and RAID level implementation transparent to the host operating system.

Replacement Table

A replacement table contains information regarding which SCSI devices have been replaced by others through standby replacement.

Rotated XOR Redundancy

This term (also known as "parity") refers to a method of providing complete data redundancy while requiring only a fraction of the storage capacity of mirroring. In a system configured under RAID 5 (which requires at least three SCSI drives), all data and parity blocks are divided between the drives in such a way that if any single drive is removed (or fails), the data on it can be reconstructed using the data on the remaining drives. (XOR refers to the Boolean "Exclusive-OR" operator.) In any RAID 5 array, the capacity allocated to redundancy is the equivalent of one drive.

SCSI Drive

A disk drive equipped with a SCSI interface (sometimes referred to as a SCSI Disk). Each disk drive will be assigned a SCSI address (or SCSI ID), which is a number from 0 to 7 (0 to 15 under Wide or Ultra SCSI). The SCSI address uniquely identifies the drive on the SCSI bus or channel.

SCSI Drive States

Refers to a SCSI drive's current operational status. At any given time, a SCSI drive can be in one of five states: READY, ONLINE, STANDBY, DEAD, or REBUILD.

The controller stores the state of the attached SCSI drives in its non-volatile memory. This information is retained even after power-off. Hence, if a SCSI disk is labeled DEAD in one session, it will stay in the DEAD state until a change is made either by using a system level utility or after a rebuild. Each of the states is described below:

Ready: A SCSI disk drive is in a "ready" state if it...

Is powered on; and

Is available to be configured during the current session but remains unconfigured.

Online: A SCSI disk drive is in an "online" state if it...

Is powered on; and

Has been defined as a member of a drive group; and

Is operating properly.

Standby: A SCSI disk drive is in a "standby" state if it...

Is powered on; and

Is able to operate properly; and

Was NOT defined as part of any drive group.

Dead: A SCSI disk drive is in a "dead" state if it...

Is not present; or

If it is present but not powered on; or

If it failed to operate properly and was 'killed' by the controller.

When the controller detects a failure on a disk, it “kills” that disk by changing its state to “dead.” A SCSI drive in a dead state does not participate in any I/O activity. No commands are issued to dead drives.

Rebuild: A SCSI disk drive is in a “rebuild” state...

While it is in the process of being rebuilt. During this process, data is regenerated and written to the disk drive. This state is also referred to as ‘Write-Only’ (WRO).

Segment Size

The Segment Size function, available in DAC960 firmware version 2.6 and above, is set in conjunction with stripe size and represents the size of the data “chunk” that will be read or written at one time. Under DACCF, the segment size (also known as “cache line size”) should be based on the stripe size you selected. (See Table 3-1 in Chapter 3 for the available segment size settings to use for each stripe size.) The default segment size for Mylex DAC960 controllers is 8K.

Session

Refers to the period of time between any two consecutive system shutdowns. System shutdown may be either a power off/on, or a hardware reset.

Standard Disk Drive

This term refers to a hard disk drive with SCSI, IDE, or other interface, that is attached to the host system through a standard disk controller.

Standby Replacement of Disks (“Hot Spare”)

The “Standby Replacement” (or “Hot Spare”) is one of the most important features the controller provides to achieve automatic, non-stop service with a high degree of fault-tolerance. The rebuild operation will be carried out by the controller automatically when a SCSI disk drive fails and both of the following conditions are true:

- A “standby” SCSI disk drive of identical size is found attached to the same controller;
- All of the system drives that are dependent on the failed disk are redundant system drives, e.g., RAID 1, RAID 5, RAID 0+1.

Note: The standby rebuild will only happen on the SAME DAC960 controller, never across DAC960 controllers.

A “Standby” disk can be created in one of two ways:

6. When a user runs DACCF utility, all disks attached to the controller that are NOT configured into any drive group will be automatically labeled as “standby” drives.
7. A disk may also be added (attached at a later time) to a running system and labeled as standby by using the “DAC960 Software Kit” (see appropriate chapters for DAC960 utilities for a particular operating system).

During the automatic rebuild process, system activity continues as normal. System performance may degrade slightly during the rebuild process.

To use the standby rebuild feature, you should always maintain a standby SCSI disk in your system. When a disk fails, the standby disk will automatically replace the failed drive and the data will be rebuilt. The system administrator can disconnect and remove the bad disk and replace it with a new disk. The administrator can then make this new disk a standby.

The standby replacement table has a limit of 8 automatic replacements in any session (from power-on/reset to the next power-off/reset). When the limit of 8 is reached and a disk failure occurs, the standby replacement will occur but will not be recorded in the replacement table.

To clear the ‘standby replacement’ table, reboot the system from a DOS bootable floppy, run the configuration utility and select the option ‘view/update configuration’ from the main menu. A red box labeled ‘Drive Remap List’ will be displayed. Selecting the box will allow you to continue. You should save the configuration without making any changes, and exit the configuration utility. This will clear the replacement table. You may now proceed to boot your system and continue normal operations.

In normal use, the replacement table limit of 8 should not cause any problems. Assuming that a disk fails about once a year (drives we support generally come with a 5-year warranty), the system would run continuously for a minimum of 8 years before the table would need to be cleared.

Stripe Order

The order in which SCSI disk drives appear within a drive group. This order must be maintained, and is critical to the controller's ability to 'Rebuild' failed drives.

Stripe Size

The stripe size is defined as the size, in kilobytes (1024 bytes) of a single I/O operation. A stripe of data (data residing in actual physical disk sectors, which are logically ordered first to last) is divided over all disks in the drive group.

Stripe Width

The number of striped SCSI drives within a drive group.

Striping

Refers to the storing of a sequential block of incoming data across multiple SCSI drives in a group. For example, if there are 3 SCSI drives in a group, the data will be separated into blocks and block 1 of the data will be stored on SCSI drive 1, block 2 on SCSI drive 2, block 3 on SCSI drive 3, block 4 on SCSI drive 1, block 5 on SCSI drive 2 and so on. This storage method increases the disk system throughput by ensuring a balanced load among all drives.

System Drives

A system drive is equivalent to a "logical" drive. System drives are presented to the operating system as available disk drives, each with a capacity specified by the DAC960 Series controller.

Target ID

A target ID is the SCSI ID of a device attached to a DAC960 Series controller. Under firmware versions below 2.6, each SCSI channel can have up to 7 attached SCSI devices (target ID from 0 to 6). Under firmware versions at or above 2.6, each SCSI channel can have up to 15 attached SCSI devices (target ID from 0 to 6, and 8 to 15).

Write Back Cache

Refers to a caching strategy whereby write operations result in a completion signal being sent to the host operating system as soon as the cache (not the disk drive) receives the data to be written. The target SCSI drive will receive the data at a more appropriate time, in order to increase controller performance. An optional cache battery backup can be used to protect against data loss as a result of a power failure or system crash.

Write Through Cache

Refers to a caching strategy whereby data is written to the SCSI drive before a completion status is returned to the host operating system. This caching strategy is considered more secure, since a power failure will be less likely to cause loss of data. However, a write through cache results in a slightly lower performance.

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